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ABSTRACT

The mathematics standards contained in this document represent a continuation of the Kansas State Board of Education efforts to set high performance expectation levels for the learning of all Kansas students. The guide lists 15 mathematics curriculum outcomes: number sense, number properties, number systems, number operations, patterns, functions, algebraic concepts, models, geometric properties, estimation and measurement, geometry from an algebraic perspective, transformational geometry, probability, data analysis, and decision making using statistics and probability. These outcomes are further broken down into fourth, eight, and tenth grade levels and include outcome illustrations, topic and activity suggestions, sample problems, and additional source information found in the Curriculum and Evaluation Standards of the National Council of Teachers of Mathematics. The majority of the topics contains sample problems for each curriculum outcome at each grade level. (MKR)

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ED 368 546

KANSAS MATHEMATICS CURRICULUM STANDARDS

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INTRODUCTION

1993 Mathematics Curriculum Standards Development History

The Kansas State Board of Education developed and adopted the Kansas Mathematics Improvement Program in 1989. As part of that plan, Kansas Mathematics Curriculum Standards were developed by Kansas educators in 1990. The 1992 Kansas legislature, in adopting the State Board's Kansas Quality Performance Accreditation program and recognizing the importance of the State Board's work in preparing curricular outcomes, directed that further work be done in mathematics, communication, social studies, and science. The legislature's direction included outcomes at a minimum of three "benchmark"/grade levels representing early elementary, middle/junior high school, and senior high school levels. A draft copy of this version of the outcomes was distributed in the fall of 1992 in order to receive feedback from K-12 faculty and administrators, higher education faculty, professional organizations, business and other community members.

Over 200 individuals representing 78 Kansas School districts and 25 groups sent written responses to these draft outcomes. Several sessions to discuss the outcomes were held at the Kansas Association of Teachers of Mathematics (KATM) Fall Conference. These responses were used to further develop the outcomes. Members of the Kansas State Board of Education, Kansas Mathematics Improvement Program Advisory Council, members of the KATM Executive Board, and members of the 1990 *Kansas Mathematics Curriculum Standards* writing committee were invited to participate in a January teleconference to provide further revision recommendations. During that teleconference, three classroom teachers were chosen by the teleconference participants to serve as a review committee as the development of the curriculum outcomes continued. The final stage of development was completed in April, 1993, when classroom teachers were invited to develop example problems to illustrate each of the mathematics curriculum outcomes.

The mathematics writing team used an outcomes approach. Program outcomes were developed from the State Board of Education's Kansas Quality Performance Accreditation Outcomes and the Evaluation Standards from the National Council of Teachers of Mathematics' *Curriculum and Evaluation Standards for School Mathematics.*

Mathematics Grade Level Outcomes –While the State Board's Kansas Mathematics Curriculum Standards have been in place since 1989, the 1992 legislation required that benchmarks be established at a minimum of three grade levels. Although the grades ten, eight, and four were chosen, students in all grade levels should work toward achieving these outcomes. The choice of tenth grade does NOT imply that tenth grade is the last year all students should be encouraged to take mathematics.

Content Focus Areas – The grade level outcomes are organized into four focus areas:

- Number Sense and Systems
- Patterns, Functions, Algebraic Concepts, and Relationships
- Geometry and Spatial Sense
- Probability and Statistics

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Kansas Mathematics Education Mission Statement

The mission of K-12 Kansas mathematics education is to provide all Kansas students with the "mathematical power to use information to reason, to think creatively, and to formulate, solve, and reflect critically on problem situations within and outside of mathematics." *(Curriculum and Evaluation Standards for School Mathematics, NCTM, p. 205)*

Writing Team Members

Thank you to all of the Kansas mathematics educators who have contributed to the development of the Kansas Mathematics Curriculum Standards. A special thank you to the Kansas Association of Teachers of Mathematics for their work on the original Kansas Mathematics Curriculum Standards developed in 1989 and 1990 and to the Northeast Kansas Association of Teachers of Mathematics who volunteered to assist in the development of example problems for this publication.

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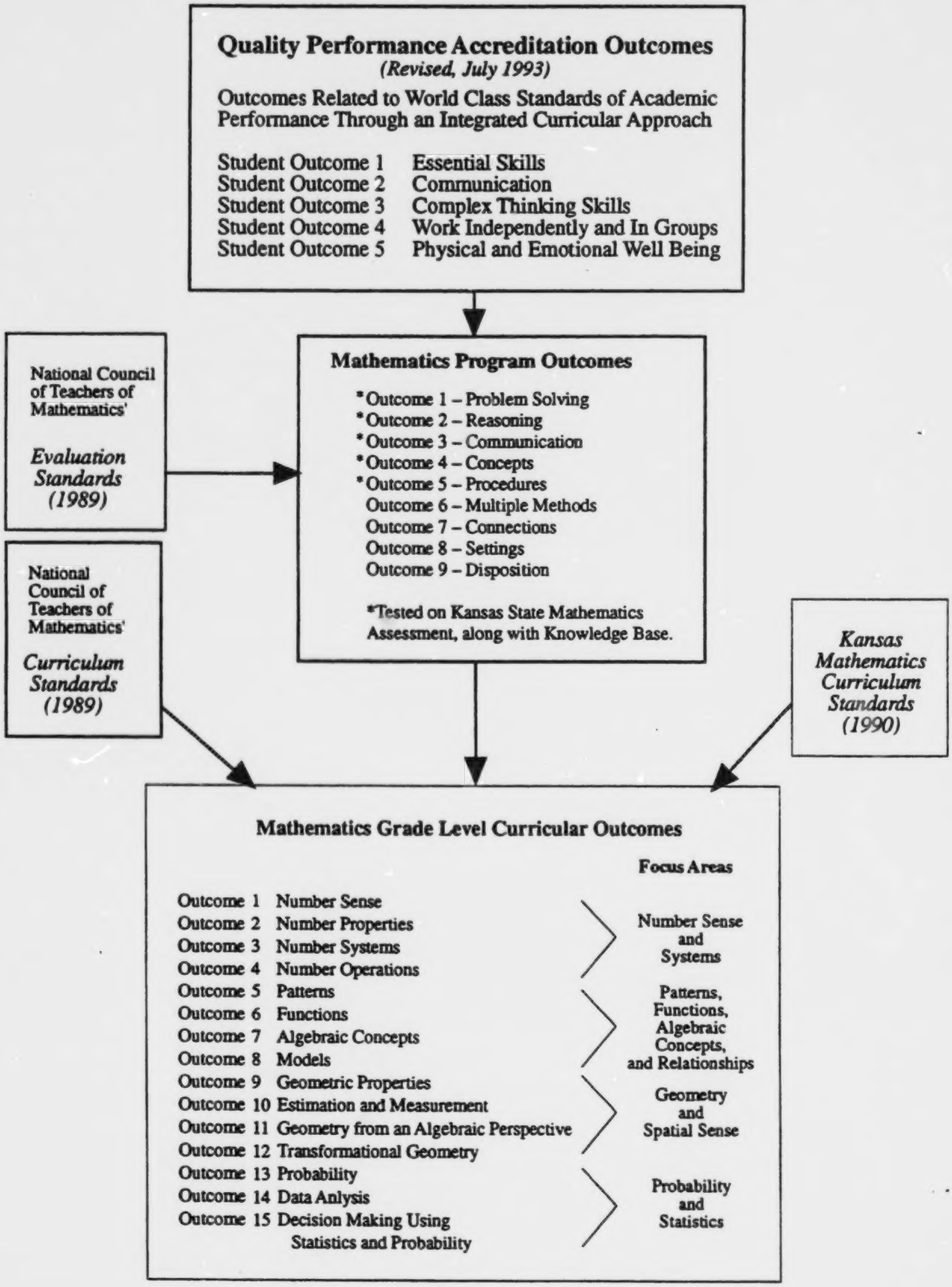
Mathematics Curriculum Standards Organizational Structure



Quality Performance Accreditation Outcomes

(Revised, July 1993)

Outcomes Related to World Class Standards of Academic Performance Through an Integrated Curricular Approach

Student Outcome 1	Essential Skills
Student Outcome 2	Communication
Student Outcome 3	Complex Thinking Skills
Student Outcome 4	Work Independently and In Groups
Student Outcome 5	Physical and Emotional Well Being

National Council of Teachers of Mathematics'

Evaluation Standards (1989)

Mathematics Program Outcomes

- *Outcome 1 – Problem Solving
- *Outcome 2 – Reasoning
- *Outcome 3 – Communication
- *Outcome 4 – Concepts
- *Outcome 5 – Procedures
- Outcome 6 – Multiple Methods
- Outcome 7 – Connections
- Outcome 8 – Settings
- Outcome 9 – Disposition

*Tested on Kansas State Mathematics Assessment, along with Knowledge Base.

National Council of Teachers of Mathematics'

Curriculum Standards (1989)

Kansas Mathematics Curriculum Standards (1990)

Mathematics Grade Level Curricular Outcomes

		Focus Areas
Outcome 1	Number Sense	Number Sense and Systems
Outcome 2	Number Properties	
Outcome 3	Number Systems	
Outcome 4	Number Operations	
Outcome 5	Patterns	Patterns, Functions, Algebraic Concepts, and Relationships
Outcome 6	Functions	
Outcome 7	Algebraic Concepts	
Outcome 8	Models	
Outcome 9	Geometric Properties	Geometry and Spatial Sense
Outcome 10	Estimation and Measurement	
Outcome 11	Geometry from an Algebraic Perspective	
Outcome 12	Transformational Geometry	
Outcome 13	Probability	Probability and Statistics
Outcome 14	Data Anlysis	
Outcome 15	Decision Making Using Statistics and Probability	

QUALITY PERFORMANCE ACCREDITATION OUTCOMES

(Revised by the Kansas State Board of Education July, 1993)

SCHOOL/DISTRICT PROCESS OUTCOMES

School/District Outcome Related to the Process of Continuous Improvement

PROCESS OUTCOME 1: Each school and district will implement and practice effective school principles and procedures.

Outcome Related to Community-Based Programs/The Learning Community Concept

PROCESS OUTCOME 2: Each school and district will work collaboratively with its community to create a learning community.

Outcome Related to Human Resource Development/Staff Training and Retraining

PROCESS OUTCOME 3: Each school and district will demonstrate effective staff development.

STUDENT OUTCOMES

Student Outcome Related to World Class Standard of Academic Performance Through Mastery of Essential Skills

STUDENT OUTCOME 1: All students will demonstrate in academic and applied situations a high level of mastery of essential skills.

Student Outcomes Related to World Class Standards of Academic Performance Through an Integrated Curricular Approach

STUDENT OUTCOME 2: All students will demonstrate effective communication skills.

STUDENT OUTCOME 3: All students will demonstrate complex thinking skills in academic and applied situations.

STUDENT OUTCOME 4: All students will demonstrate the necessary characteristics to work effectively both independently and in groups.

STUDENT OUTCOME 5: All students will demonstrate physical and emotional well-being.

MATHEMATICS PROGRAM OUTCOMES

Mathematics Program Outcome 1: The student uses mathematics to solve problems, understanding that many problems have more than one answer, there are multiple methods of solving problems, and answers may be represented in a variety of forms.

- formulates problems
- applies a variety of strategies to solve problems
- verifies and interprets results
- generalizes solutions

Mathematics Program Outcome 2: The student uses mathematics to reason and analyze.

- recognizes valid and invalid arguments
- uses inductive reasoning to recognize patterns and form conjectures
- uses proportional and spatial reasoning to solve problems
- uses deductive reasoning to verify conclusions, judge the validity of arguments, and construct valid arguments

Mathematics Program Outcome 3: The student uses mathematical language to communicate ideas and relate written expressions, oral expressions, and mathematical symbols.

- expresses mathematical ideas by speaking, writing, demonstrating, and depicting them graphically
- understands, interprets, and evaluates mathematical ideas that are presented in written, oral, or visual forms
- uses mathematical vocabulary, notation, and structure to represent ideas, describe relationships, and model situations
- asks clarifying and extending questions relating to problem situations within and outside mathematics

Mathematics Program Outcome 4: The student applies mathematical knowledge and understanding of concepts.

- represents the same mathematical concept in different contexts, formats, and problem situations
- uses models, diagrams, and symbols to represent concepts
- identifies and generate examples and nonexamples
- identifies properties and conditions of a given concept
- compares and contrasts mathematical concepts

Mathematics Program Outcome 5: The student applies mathematical procedures.

- represents the same mathematical procedure in different contexts, formats, and problem situations
- recognizes and discusses correct and incorrect procedures
- reliably and efficiently executes procedures
- uses one or more methods to verify results
- extends or modifies existing procedures and explores new ones

Mathematics Program Outcome 6: The student chooses and applies a variety of mathematical methods to investigate, conjecture, and/or verify results.

- determines whether an estimate or exact result is needed
- selects and appropriately uses technology
- selects and appropriately uses manipulatives
- selects and appropriately uses models
- selects and appropriately uses other mathematical methods

Mathematics Program Outcome 7: The student investigates connections of mathematical ideas and applications.

- among mathematical topics;
- among mathematics and other disciplines; and
- among mathematics and real-life problem situations

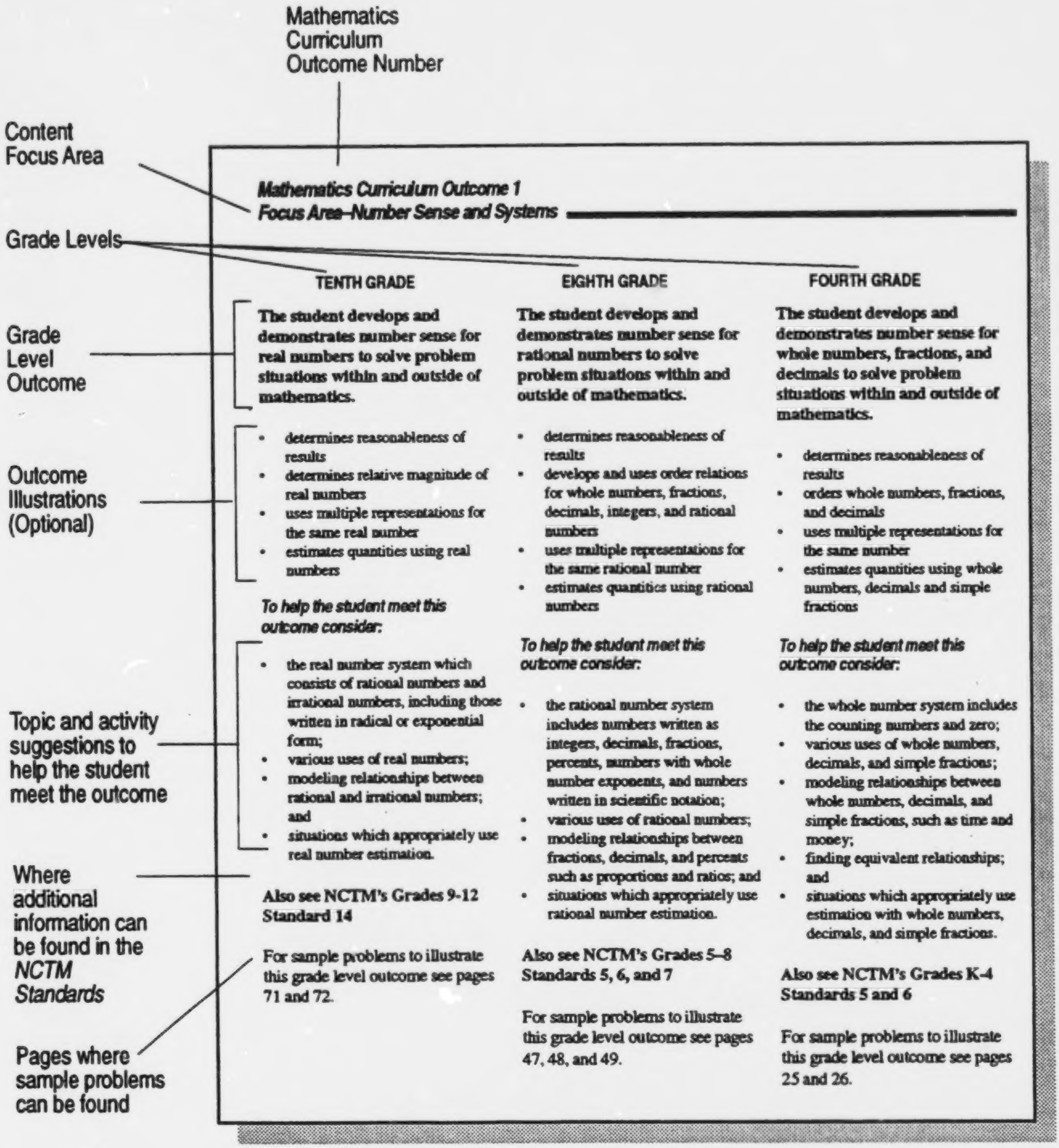
Mathematics Program Outcome 8: The student works effectively in a variety of settings to learn mathematics and to solve problem situations within and outside mathematics.

- independently
- in small discussion groups
- in large groups
- in cooperative groups

Mathematics Program Outcome 9: The student demonstrates a positive disposition toward mathematics.

- confidence in using mathematics to solve problems, to communicate ideas, and to reason
- flexibility in exploring mathematical ideas and trying alternative methods in solving problems
- willingness to persevere in mathematical tasks
- interest, curiosity, and inventiveness in doing mathematics
- inclination to monitor and reflect on their own thinking and performance
- valuing the applications of mathematics
- appreciation of the role of mathematics in a multicultural/multi-ethnic society.

Format of Mathematics Curriculum Outcomes


Mathematics Curriculum Outcome Number
Content Focus Area
Grade Levels
Grade Level Outcome
Outcome Illustrations (Optional)
Topic and activity suggestions to help the student meet the outcome
Where additional information can be found in the *NCTM Standards*
Pages where sample problems can be found

Mathematics Curriculum Outcome 1
Focus Area–Number Sense and Systems

TENTH GRADE

The student develops and demonstrates number sense for real numbers to solve problem situations within and outside of mathematics.

- determines reasonableness of results
- determines relative magnitude of real numbers
- uses multiple representations for the same real number
- estimates quantities using real numbers

To help the student meet this outcome consider:

- the real number system which consists of rational numbers and irrational numbers, including those written in radical or exponential form;
- various uses of real numbers;
- modeling relationships between rational and irrational numbers; and
- situations which appropriately use real number estimation.

Also see NCTM's Grades 9-12 Standard 14

For sample problems to illustrate this grade level outcome see pages 71 and 72.

EIGHTH GRADE

The student develops and demonstrates number sense for rational numbers to solve problem situations within and outside of mathematics.

- determines reasonableness of results
- develops and uses order relations for whole numbers, fractions, decimals, integers, and rational numbers
- uses multiple representations for the same rational number
- estimates quantities using rational numbers

To help the student meet this outcome consider:

- the rational number system includes numbers written as integers, decimals, fractions, percents, numbers with whole number exponents, and numbers written in scientific notation;
- various uses of rational numbers;
- modeling relationships between fractions, decimals, and percents such as proportions and ratios; and
- situations which appropriately use rational number estimation.

Also see NCTM's Grades 5–8 Standards 5, 6, and 7

For sample problems to illustrate this grade level outcome see pages 47, 48, and 49.

FOURTH GRADE

The student develops and demonstrates number sense for whole numbers, fractions, and decimals to solve problem situations within and outside of mathematics.

- determines reasonableness of results
- orders whole numbers, fractions, and decimals
- uses multiple representations for the same number
- estimates quantities using whole numbers, decimals and simple fractions

To help the student meet this outcome consider:

- the whole number system includes the counting numbers and zero;
- various uses of whole numbers, decimals, and simple fractions;
- modeling relationships between whole numbers, decimals, and simple fractions, such as time and money;
- finding equivalent relationships; and
- situations which appropriately use estimation with whole numbers, decimals, and simple fractions.

Also see NCTM's Grades K-4 Standards 5 and 6

For sample problems to illustrate this grade level outcome see pages 25 and 26.

Mathematics Curriculum Outcome 1
Focus Area–Number Sense and Systems

TENTH GRADE

The student develops and demonstrates number sense for real numbers to solve problem situations within and outside of mathematics.

- determines reasonableness of results
- determines relative magnitude of real numbers
- uses multiple representations for the same real number
- estimates quantities using real numbers

To help the student meet this outcome consider:

- the real number system which consists of rational numbers and irrational numbers, including those written in radical or exponential form;
- various uses of real numbers;
- modeling relationships between rational and irrational numbers; and
- situations which appropriately use real number estimation.

Also see NCTM's Grades 9-12 Standard 14

For sample problems to illustrate this grade level outcome see pages 71 and 72.

EIGHTH GRADE

The student develops and demonstrates number sense for rational numbers to solve problem situations within and outside of mathematics.

- determines reasonableness of results
- develops and uses order relations for whole numbers, fractions, decimals, integers, and rational numbers
- uses multiple representations for the same rational number
- estimates quantities using rational numbers

To help the student meet this outcome consider:

- the rational number system includes numbers written as integers, decimals, fractions, percents, numbers with whole number exponents, and numbers written in scientific notation;
- various uses of rational numbers;
- modeling relationships between fractions, decimals, and percents such as proportions and ratios; and
- situations which appropriately use rational number estimation.

Also see NCTM's Grades 5–8 Standards 5, 6, and 7

For sample problems to illustrate this grade level outcome see pages 47, 48, and 49.

FOURTH GRADE

The student develops and demonstrates number sense for whole numbers, fractions, and decimals to solve problem situations within and outside of mathematics.

- determines reasonableness of results
- orders whole numbers, fractions, and decimals
- uses multiple representations for the same number
- estimates quantities using whole numbers, decimals and simple fractions

To help the student meet this outcome consider:

- the whole number system includes the counting numbers and zero;
- various uses of whole numbers, decimals, and simple fractions;
- modeling relationships between whole numbers, decimals, and simple fractions, such as time and money;
- finding equivalent relationships; and
- situations which appropriately use estimation with whole numbers, decimals, and simple fractions.

Also see NCTM's Grades K-4 Standards 5 and 6

For sample problems to illustrate this grade level outcome see pages 25 and 26.

Mathematics Curriculum Outcome 2
Focus Area–Number Sense and Systems

TENTH GRADE

The student recognizes, applies and justifies properties of the real number system and its operations.

To help the student meet this outcome consider the following real number properties:

- closure properties;
- equivalence properties;
- commutative properties;
- associative properties;
- distributive property;
- substitution property;
- identity properties; and
- inverse properties.

Also see NCTM's Grades 9-12 Standard 14

For sample problems to illustrate this grade level outcome see pages 73 and 74.

EIGHTH GRADE

The student recognizes, applies, and explains properties of the rational number system and its operations.

To help the student meet this outcome consider the following rational number properties:

- commutative properties;
- associative properties;
- distributive property;
- substitution property;
- identity properties; and
- inverse properties.

Also see NCTM's Grades 5-8 Standard 6

For sample problems to illustrate this grade level outcome see page 50.

FOURTH GRADE

The student explores properties of whole numbers, fractions, mixed numbers, and decimals.

To help the student meet this outcome consider the following whole number properties:

- commutative properties;
- associative properties;
- distributive property; and
- identity properties.

Also see NCTM's Grades K-4 Standard 7

For sample problems to illustrate this grade level outcome see page 27.

TENTH GRADE

The student investigates the history and structure of the real number system.

- models and explains relationships among counting numbers, whole numbers, rational numbers, irrational numbers, and real numbers
- understands and appreciates the need for numbers beyond the rational numbers

See also NCTM's Grades 9-12 Standard 14

For sample problems to illustrate this grade level outcome see page 75.

EIGHTH GRADE

The student investigates the history and structure of the rational number system.

- models and explains the relationships among counting numbers, whole numbers, integers, fractions, and rational numbers
- understands and appreciates the need for numbers beyond the whole numbers, simple fractions, mixed numbers, and decimals
- explores irrational numbers such as pi and square roots

See also NCTM's Grades 5-8 Standards 5 and 6

For sample problems to illustrate this grade level outcome see page 51.

FOURTH GRADE

The student investigates counting numbers, whole numbers, fractions, mixed numbers, and decimals with a special emphasis on place value.

- models and explains the relationsips among counting numbers, whole numbers, simple fractions, mixed numbers, and decimals
- understands and appreciates the need for numbers beyond the whole numbers
- understands our numeration system by relating counting, grouping, and place-value concepts

See also NCTM's Grades K-4 Standard 6

For sample problems to illustrate this grade level outcome see pages 28 and 29.

Mathematics Curriculum Outcome 4
Focus Area–Number Sense and Systems

TENTH GRADE

The student explains, models, and performs operations with algebra and the real number system to solve problem situations within and outside mathematics.

- selects and uses appropriate real number estimation and computation
- selects and uses appropriate computational tools
- develops, analyzes, and explains computational procedures and estimation strategies
- uses estimation to check reasonableness of results

To help the student in meeting this outcome consider the following:

- algebra and the real number system include expressions written in radical and exponential form;
- estimation with algebraic expressions and real numbers;
- computational methods include mental math, paper and pencil, and using manipulatives and technology;
- models for operations with algebraic expressions and real numbers, such as using algebra tiles to add, subtract, multiply, or divide; and
- models for powers and roots of algebraic expressions and real numbers, such as tiles, cubes, or geoboards.

See also NCTM's Grades 9-12 Standard 5

For sample problems to illustrate this grade level outcome see pages 76 and 77.

EIGHTH GRADE

The student explains, models, and performs operations with simple algebra and the rational number system to solve problem situations within and outside mathematics.

- selects and uses appropriate rational number estimation and computation
- selects and uses appropriate computational tools
- develops and explains computational procedures and estimation strategies
- uses estimation to check reasonableness of results

To help the student in meeting this outcome consider the following:

- the rational number system includes numbers written as integers, decimals, fractions, percents, numbers written with whole number exponents and in scientific notation;
- estimation with simple algebraic expressions and rational numbers;
- computational methods include mental math, paper and pencil, and using manipulatives and technology;
- rational number models, such as fractional pieces or base ten blocks; and

(continued on next page)

FOURTH GRADE

The student explains, models, and performs operations with whole numbers to solve problem situations within and outside of mathematics. The student explores operations with fractions, mixed numbers, and decimals.

- selects and performs appropriate whole number and estimation computation
- selects and uses appropriate computational tools
- develops and explains computational procedures and estimation strategies
- uses estimation to check reasonableness of results

To help the student in meeting this outcome consider the following:

- computation and estimation involving whole number addition, subtraction, multiplication, and division;
- addition and subtraction with simple fractions, mixed numbers, and decimals;
- estimation with fractions, mixed numbers, and decimal using addition and subtraction;
- computational methods include mental math, paper and pencil, and using manipulatives and technology;
- whole number models, such as jelly beans, pattern blocks, or tiles;
- fraction, mixed number, and decimal models, such as fraction pieces, base ten blocks, or money; and

(continued on next page)

Mathematics Curriculum Outcome 4
Focus Area–Number Sense and Systems
Cont.'

TENTH GRADE

EIGHTH GRADE

To help the student meet this outcome consider the following:

- process models for rational number operations, such as:
  1) addition - putting together, slides on the number line
  2) subtraction - taking away, missing addend, comparison
  3) multiplication - arrays, areas, rate factor, magnification, reduction, or successive addition
  4) division - ratios, rates, missing factor, partitioning, successive subtraction
  5) powers and rational roots–partitioning.

See also NCTM's Grades 5-8 Standards 7 and 9

For sample problems to illustrate this grade level outcome see pages 52, 53, and 54.

FOURTH GRADE

To help the student meet this outcome consider the following:

- process models for number operations, such as:
  1) addition - putting together, slides on the number line
  2) subtraction - taking away, missing addend, comparison
  3) multiplication - successive addition
  4) division - missing factor, successive subtraction.

See also NCTM's Grades K-4 Standards 5, 8, and 12

For sample problems to illustrate this grade level outcome see pages 30 and 31.

Mathematics Curriculum Outcome 5

Focus Area–Patterns, Functions, Algebraic Concepts and Relationships

TENTH GRADE

The student recognizes, describes, extends, develops, and analyzes a wide variety of patterns from problem situations within and outside of mathematics.

To help the student meet this outcome consider patterns such as:

- real number patterns;
- algebraic patterns;
- geometric patterns;
- probability patterns;
- numeric, geometric, and situational sequences;
- arithmetic and geometric series;
- exponential patterns, such as growth and decay;
- conceptual foundations of limits; and
- cyclical patterns.

See also NCTM's Grades 9-12 Standards 5, 6, 7, 9, 11, and 13

For sample problems to illustrate this grade level outcome see pages 78, 79, and 80.

EIGHTH GRADE

The student recognizes, describes, extends, develops, and explains a wide variety of patterns from problem situations within and outside of mathematics.

To help the student meet this outcome consider patterns such as:

- rational number patterns;
- exponential and growth patterns;
- number theory patterns, such as primes, factors, and multiples;
- measurement and geometric patterns;
- basic algebraic patterns;
- probability patterns;
- simple arithmetic and geometric sequences; and
- patterns occurring in nature.

See also NCTM's Grades 5-8 Standards 8, 9, and 10

For sample problems to illustrate this grade level outcome see page 55.

FOURTH GRADE

The student recognizes, describes, extends, develops, and explains the relationships in a wide variety patterns from problem situations within and outside of mathematics.

To help the student meet this outcome consider patterns such as:

- whole number patterns;
- mixed number and decimal patterns;
- visual patterns such as color or shape;
- geometric patterns;
- calendars;
- money and time patterns;
- patterns occurring in nature;
- number charts; and
- kinesthetic patterns such as clapping.

See also NCTM's Grades K-4 Standard 13

For sample problems to illustrate this grade level outcome see pages 32 and 33.

Mathematics Curriculum Outcome 6
Focus Area–Patterns, Functions, Algebraic Concepts and Relationships

TENTH GRADE

The student recognizes, defines, and describes a wide variety of functions, and uses appropriate graphing technology to graph and analyze functions.

- determines intercepts, maximums, and minimums
- understands general characteristics of functions
- analyzes the effects of parameter changes on the graphs of functions
- translates among tabular, symbolic, and graphical representation of functions

To help the student meet this outcome consider the following:

- step functions;
- absolute value functions;
- constant functions;
- linear and quadratic functions;
- exponential functions;
- inverse functions; and
- basic trigonometric functions.

See also NCTM's Grades 9-12 Standards 6 and 13

For sample problems to illustrate this grade level outcome see pages 81 and 82.

EIGHTH GRADE

The student recognizes and describes linear functions and uses appropriate graphing technology to graph and analyze linear functions.

- understands x and y intercepts
- explores slope as a characteristic of a linear function

To help the student meet this outcome consider the following:

- rates of change; and
- direct and indirect variation.

See also NCTM's Grades 5-8 Standards 8 and 9

For sample problems to illustrate this grade level outcome see page 56.

FOURTH GRADE

The student explores the concept of function.

- makes generalizations about patterns
- uses letters and symbols to describe relationships
- recognizes and uses appropriate terminology to describe functions.

To help the student meet this outcome consider the following:

- terminology, such as input and output;
- skip counting; and
- constant functions.

See also NCTM's Grades K-4 Standard 13

For sample problems to illustrate this grade level outcome see page 34.

Mathematics Curriculum Outcome 7
Focus Area–Patterns, Functions, Algebraic Concepts and Relationships

TENTH GRADE

The student uses algebra to represent and solve problems situations within and outside of mathematics.

- recognizes, interprets, and manipulates variable quantities
- solves linear and quadratic equations
- solves linear and quadratic inequalities
- appreciates the power of mathematical abstraction and symbolism

To help the student meet this outcome consider:

- matrices; and
- linear programming.

See also NCTM's Grades 9-12 Standard 5

For sample problems to illustrate this grade level outcome see pages 83 and 84.

EIGHTH GRADE

The student recognizes, interprets, explains, and manipulates expressions involving variables. The student uses linear equations and inequalities to solve problem situations within and outside of mathematics.

- understands the concept of variable
- uses variables to generalize patterns, tables, graphs, and charts
- explains the difference between an equation and an expression
- verbalizes the meaning of symbolic expressions

See also NCTM's Grades 5-8 Standard 9

For sample problems to illustrate this grade level outcome see pages 57 and 58.

FOURTH GRADE

The student uses whole number equations and inequalities to solve problem situations within and outside of mathematics. The student explores simple equations and inequalities involving fractions, mixed numbers, and decimals.

- uses symbols for unknown quantities
- writes and solves simple equations

To help the student meet this outcome consider:

- missing parts of addition, subtraction, multiplication, and division equations;
- situations involving time and money;
- writing equations from word problems; and
- writing word problems to represent a given equation.

See also NCTM's Grades K-4 Standards 7 and 13

For sample problems to illustrate this grade level outcome see page 35.

Mathematics Curriculum Outcome 8
Focus Area–Patterns, Functions, Algebraic Concepts and Relationships

TENTH GRADE

The student develops and uses models to represent and justify mathematical relationships and to assist in the solution of problem situations within and outside of mathematics.

To help the student meet this outcome consider:

- algebraic models;
- geometric models;
- models for operations;
- tables and graphs;
- matrices;
- probability models;
- networks; and
- Venn diagrams.

See also NCTM's Grades 9-12 Standards 5, 6, 7, 10, 11, and 12

For sample problems to illustrate this grade level outcome see page 85.

EIGHTH GRADE

The student develops and uses models to represent and justify mathematical relationships and to assist in the solution of problem situations within and outside of mathematics.

To help the student meet this outcome consider:

- algebraic models;
- rational number models;
- geometric models;
- process models for rational number operations;
- tables and graphs;
- probability models; and
- Venn diagrams.

See also NCTM's Grades 5-8 Standards 8, 9, 10, 11, and 12

For sample problems to illustrate this grade level outcome see page 59.

FOURTH GRADE

The student develops and uses models to represent and justify mathematical relationships and to assist in the solution of problem situations within and outside of mathematics.

To help the student meet this outcome consider:

- simple tree diagrams;
- tables, charts, and graphs;
- geometric models;
- pattern and relationship models;
- whole number models;
- fraction, mixed number, and decimal models;
- process models for whole number operations; and
- Venn diagrams.

See also NCTM's Grades K-4 Standards 7, 8, 9, 11, 12, and 13

For sample problems to illustrate this grade level outcome see page 36.

Mathematics Curriculum Outcome 9
Focus Area–Geometry and Spatial Sense

TENTH GRADE

The student recognizes, applies, compares, and justifies properties of geometric figures using appropriate technology, manipulatives, or constructions.

To help the student meet this outcome consider:

- any two-dimensional figure including ellipses, hyperbolas, and parabolas;
- three-dimensional figures;
- intersections of two-dimensional figures, three-dimensional figures, and two dimensional figures with three dimensional figures;
- recognition of triples, such as SSS, SAS, ASA, that ensure unique results;
- ratios in right triangles; and
- arguments using paragraphs; models; and deductive, inductive, indirect, spatial and proportional reasoning;
- describe and draw three-dimensional figures.

See also NCTM's Grades 9-12 Standards 7, 8, and 9

For sample problems to illustrate this grade level outcome see page 86.

EIGHTH GRADE

The student recognizes, applies, and compares properties of common geometric figures using appropriate technology, manipulatives, or constructions.

To help the student meet this outcome consider:

- geometric figures, including points, lines, rays, planes, angles, circles, and polygons;
- common three-dimensional figures, including cubes, prisms, pyramids, cylinders, cones, and spheres;
- intersections of two-dimensional figures;
- geometric properties, including congruency, similarity, convex, and concave; and
- recognition of Pythagorean triples in right triangles.

See also NCTM's Grades 5-8 Standard 12

For sample problems to illustrate this grade level outcome see page 60.

FOURTH GRADE

The student recognizes and investigates properties of simple geometric figures using appropriate technology, manipulatives, or constructions.

To help the student meet this outcome consider:

- geometric figures including points, lines, and line segments;
- common plane and solid shapes including circle, rectangle, and the basic pattern block shapes (square, triangle, rhombus, hexagon, parallelogram, and trapezoid);
- common three-dimensional figures, including cube, rectangular prism, sphere, and cone;
- basic geometric properties, including symmetry, congruency, parallel and perpendicular; and
- shapes created by combining, subdividing, and changing shapes.

See also NCTM's Grades K-4 Standard 9

For sample problems to illustrate this grade level outcome see pages 37, 38, and 39.

Mathematics Curriculum Outcome 10
Focus Area–Geometry and Spatial Sense

TENTH GRADE

The student uses estimation, measurement, and geometric properties to solve problem situations with and outside of mathematics.

- describes two- and three-dimensional relationships
- applies a variety of measurement formulas
- justifies simple measurement formulas
- selects appropriate measurement tools, appropriate units of measure, and appropriate degrees of accuracy
- investigates basic trigonometric relationships

To help the student meet this outcome consider:

- angles, volumes, perimeters, circumference, arc length, rate of change, growth and decay, distance, and area (including irregular figures), sectors, and area under curves;
- impact of changing parameters, such as how a range in the diameter effects the surface area of a sphere;
- indirect measurement to measure inaccessible objects; and
- unit circle to investigate trigonometric ratios.

See also NCTM's Grades 9-12 Standards 7 , 8, and 9

For sample problems to illustrate this grade level outcome see pages 87 and 88.

EIGHTH GRADE

The student uses estimation, measurement, and measurement formulas to solve problem situations within and outside of mathematics.

- describes attributes of two-dimensional figures and common three-dimensional figures
- investigates measurement formulas
- applies basic measurement formulas
- selects appropriate measurement tools, appropriate units of measurement, and appropriate degrees of accuracy

To help the student meet this outcome consider:

- common three-dimensional figures include cubes, prisms, pyramids, cylinders, cones, and spheres;
- degrees, length, distance, perimeters, circumference, area, volume, time, weight/mass, temperature, and capacity;
- impact of changing parameters, such as how doubling the sides of a square effects the area;
- appropriate comparisons between measurement systems;
- appropriate conversions within measurement systems; and
- appropriate measurements to measure inaccessible objects.

See also NCTM's Grades 5-8 Standards 12 and 13

For sample problems to illustrate this grade level outcome see pages 61, 62, and 63.

FOURTH GRADE

The student uses estimation and measurement involving standard and non-standard units to solve problem situations within and outside of mathematics.

- describes attributes of common two dimensional figures
- selects appropriate measurement tools, appropriate units of measurement, and appropriate degrees of accuracy

To help the student meet this outcome consider:

- common two-dimensional figures include circle, rectangle, and the basic pattern block shapes (square, triangle, rhombus, hexagon, parallelogram, and trapezoid);
- attributes include length, perimeter, area, volume, time, weight, temperature, and capacity;
- appropriate measurement tools, such as rulers, protractors, or measuring cups;
- appropriate comparisons between measurement systems; and
- appropriate conversions within measurement systems.

See also NCTM's Grades K-4 Standards 5, 9 and 10

For sample problems to illustrate this grade level outcome see pages 40 and 41.

Mathematics Curriculum Outcome 11
Focus Area–Geometry and Spatial Sense

TENTH GRADE

The student uses an algebraic perspective to analyze the geometry of two and three dimensions to solve problem situations within and outside of mathematics.

To help the student meet this outcome consider:

- distance and midpoint formulas on the coordinate plane;
- slopes of parallel and perpendicular lines;
- geometric properties with respect to the coordinate plane;
- Pythagorean Theorem; and
- ordered triples to describe locations in three space.

See also NCTM's Grades 9-12 Standard 8

For sample problems to illustrate this grade level outcome see page 89.

EIGHTH GRADE

The student investigates and explores two-dimensional geometry from an algebraic perspective to solve problem situations within and outside of mathematics.

To help the student meet this outcome consider:

- Cartesian Coordinate System;
- distance and midpoint formulas on the number line;
- slope of a line; and
- Pythagorean Theorem.

See also NCTM's Grades 5-8 Standards 9, 12, and 13

For sample problems to illustrate this grade level outcome see page 64.

FOURTH GRADE

The student relates geometric and measurement concepts to numbers to solve problem situations within and outside of mathematics.

To help the student meet this outcome consider:

- number lines to represent distance;
- ordered pairs in the first quadrant;
- perimeter;
- area; and
- volume.

See also NCTM's Grades K-4 Standards 9 and 10

For sample problems to illustrate this grade level outcome see page 42.

Mathematics Curriculum Outcome 12
Focus Area–Geometry and Spatial Sense

TENTH GRADE

The student recognizes, develops and applies transformations of geometric figures to solve problem situations within and outside of mathematics.

To help the student meet this outcome consider:

- basic transformations, such as rotation, reflection, translation, shrink, or magnify, applied to two- and three-dimensional figures;
- rotations of multiples of 90 degrees;
- analysis of properties of geometric figures under various sets of transformations;
- exploration of transformations;
- introduction of vectors to represent translations; and
- scale drawings.

See also NCTM's Grades 9-12 Standards 7 and 8

For sample problems to illustrate this grade level outcome see pages 90 and 91.

EIGHTH GRADE

The student recognizes and performs transformations of two-dimensional geometric figures to solve problems within and outside of mathematics.

To help the student meet this outcome consider:

- basic transformations, such as rotation, reflection, translation, shrink, or magnify;
- exploration of transformations;
- impact of transformation on area and perimeter; and
- ratios.

See also NCTM's Grades 5-8 Standards 12 and 13

For sample problems to illustrate this grade level outcome see page 65.

FOURTH GRADE

The student recognizes and explores transformations of basic geometric figures to solve problem situations within and outside of mathematics.

To help the student meet this outcome consider:

- basic transformations, such as reflection, translation, or rotation (i.e., flips, slides, and turns); and
- exploration of transformations.

See also NCTM's Grades K-4 Standards 9 and 10

For sample problems to illustrate this grade level outcome see page 43.

Mathematics Curriculum Outcome 13
Focus Area–Probability and Statistics

TENTH GRADE

The student formalizes probability theory.

- devises and conducts appropriate experiments and simulations for given situations
- compares empirical results with theoretical results
- applies combinatorics and probability theory
- analyzes the use of probability in the real world

To help the student meet this outcome consider:

- Pascal's triangle and its properties;
- permutations and combinations;
- random variable;
- odds and chance;
- conditional probability;
- compound probability;
- appropriate sample spaces; and
- one, two or three-dimensional probability models.

Also see NCTM's Grades 9-12 Standards 11 and 12

For sample problems to illustrate this grade level outcome see page 92.

EIGHTH GRADE

The student explores the use of probability in real-life situations.

- devises and conducts experiments and simulations
- compares empirical results with theoretical results
- investigates combinatorics and probability theory
- recognizes the many uses of probability in the real world

To help the student meet this outcome consider:

- sequential counting methods;
- combinations and permutations;
- simple binomial experiments;
- factorial notation;
- appropriate sample spaces; and
- one- and two-dimensional probability models.

Also see NCTM's Grades 5-8 Standard 11

For sample problems to illustrate this grade level outcome see page 66.

FOURTH GRADE

The student explores chance and counting techniques.

- conducts simple experiments and simulations
- compares experimental results with expected results

To help the student meet this outcome consider:

- likelihood and certainty; and
- perceptions of luck.

Also see NCTM's Grades K-4 Standard 11

For sample problems to illustrate this grade level outcome see page 44.

Mathematics Curriculum Outcome 14
Focus Area–Probability and Statistics

TENTH GRADE

The student generates, reads, organizes and interprets data and uses data to draw inferences from problem situations within and outside of mathematics.

- analyzes the effects of data transformations on measures of central tendency
- infers appropriate conclusions from data displayed in a variety of formats
- understands sampling and recognizes its role in statistical claims
- understands and applies measures of dispersion (standard deviation and variance)
- understands and applies measures of correlation

To help the student meet this outcome consider:

- distributions, including frequency, normal, binomial, and uniform;
- box plots, histograms, stem-and-leaf plots, and scatter plots;
- matrices;
- measures of position - percentiles and quartiles;
- measures of correlation;
- line of best fit and curve fitting;
- impact of data and scale changes;
- tables and graphs; and
- testing of hypotheses using appropriate statistics.

Also see NCTM's Grades 9-12 Standards 10 and 12

For sample problems to illustrate this grade level outcome see pages 93, 94, and 95.

EIGHTH GRADE

The student generates, reads, organizes and interprets data from problem situations within and outside of mathematics.

- understands and applies measures of central tendency (mean, median, and mode)
- selects and displays data in appropriate formats
- identifies and applies valid sampling techniques
- calculates and interprets the range of a set of data

To help the student meet this outcome consider:

- frequency distributions;
- box plots;
- histograms;
- stem-and-leaf plots;
- scatter plots;
- line plots;
- tables and graphs, including circle graphs;
- Venn Diagrams;
- pictorial models;
- simple networks such as trees and paths; and
- making convincing arguments based on data.

Also see NCTM's Grades 5-8 Standard 10

For sample problems to illustrate this grade level outcome see pages 67 and 68.

FOURTH GRADE

The student collects, reads, and interprets data from problem situations within and outside of mathematics.

- models, calculates and explains the mean, median, mode, and range
- displays data in a variety of formats

To help the student meet this outcome consider:

- tables, charts, and simple tree diagrams;
- pictorial, bar, and line graphs using whole numbers, fractions, mixed numbers, and decimals;
- appropriate choice and use of horizontal and vertical scales;
- ordered pairs in the first quadrant; and
- simple tree diagrams.

Also see NCTM's Grades K-4 Standard 11

For sample problems to illustrate this grade level outcome see page 45.

Mathematics Curriculum Outcome 15
Focus Area–Probability and Statistics

TENTH GRADE

The student uses data analysis, statistics, and probability to analyze the validity of arguments, draw conclusions and make decisions to solve problem situations within and outside of mathematics.

See also NCTM's Grades 9-12 Standards 5, 10, 11, and 12

For sample problems to illustrate this grade level outcome see page 96.

EIGHTH GRADE

The student uses data analysis, statistics, and probability to generate convincing arguments, to draw conclusions, and to make decisions to solve problem situations within and outside of mathematics.

See also NCTM's Grades 5-8 Standards 10 and 11

For sample problems to illustrate this grade level outcome see pages 69 and 70.

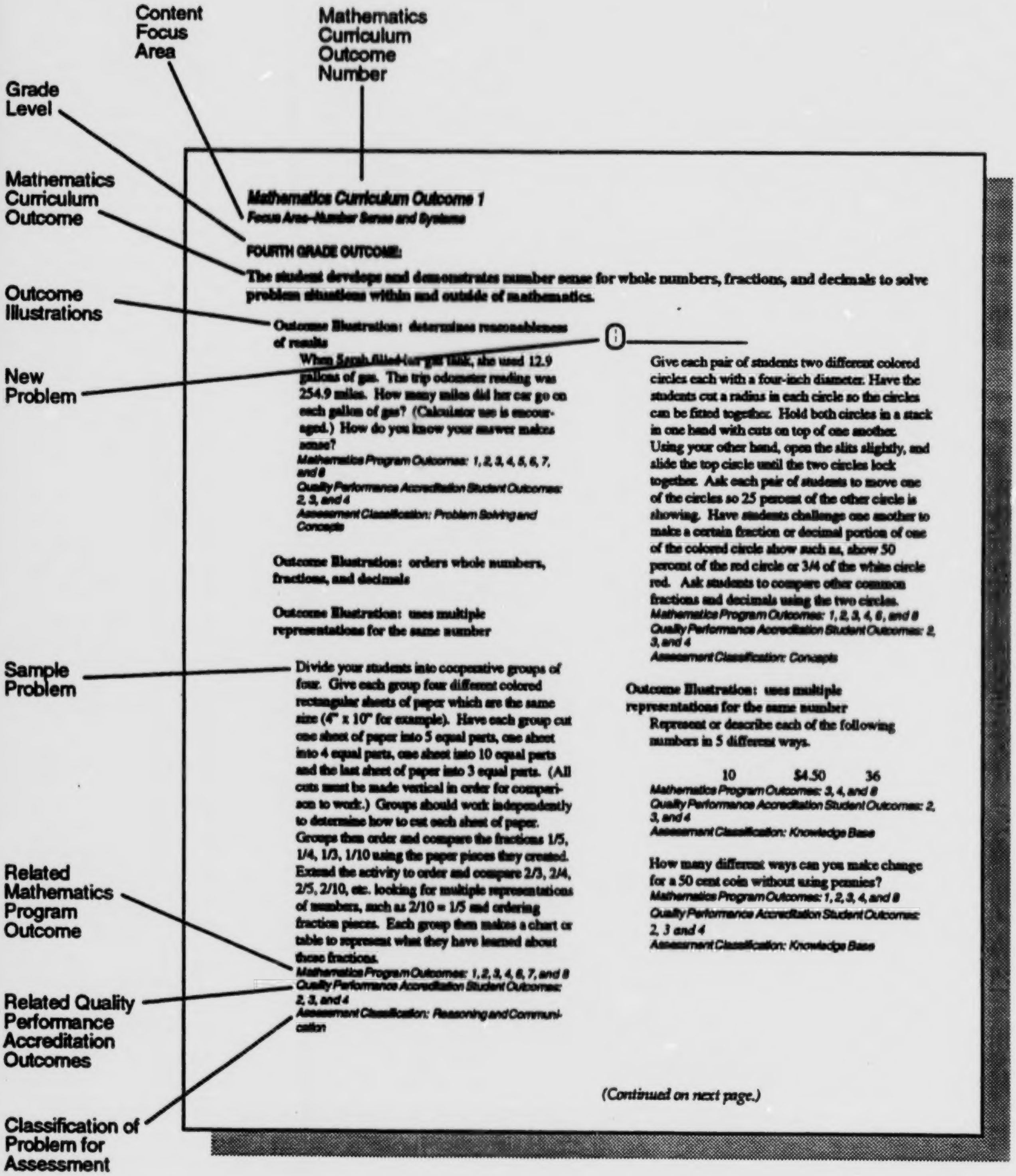
FOURTH GRADE

The student uses data analysis, statistics, and probability to make decisions and predictions.

See also NCTM's Grades K-4 Standard 11

For sample problems to illustrate this grade level outcome see page 46.

Format of Sample Problems


Content Focus Area
Mathematics Curriculum Outcome Number
Grade Level
Mathematics Curriculum Outcome
Outcome Illustrations
New Problem
Sample Problem
Related Mathematics Program Outcome
Related Quality Performance Accreditation Outcomes
Classification of Problem for Assessment

Mathematics Curriculum Outcome 1

Focus Area–Number Sense and Systems

FOURTH GRADE OUTCOME:

The student develops and demonstrates number sense for whole numbers, fractions, and decimals to solve problem situations within and outside of mathematics.

Outcome Illustration: determines reasonableness of results

When Sarah filled her gas tank, she used 12.9 gallons of gas. The trip odometer reading was 254.9 miles. How many miles did her car go on each gallon of gas? (Calculator use is encouraged.) How do you know your answer makes sense?

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8

Quality Performance Accreditation Student Outcomes: 2, 3, and 4

Assessment Classification: Problem Solving and Concepts

Outcome Illustration: orders whole numbers, fractions, and decimals

Outcome Illustration: uses multiple representations for the same number

Divide your students into cooperative groups of four. Give each group four different colored rectangular sheets of paper which are the same size (4" x 10" for example). Have each group cut one sheet of paper into 5 equal parts, one sheet into 4 equal parts, one sheet into 10 equal parts and the last sheet of paper into 3 equal parts. (All cuts must be made vertical in order for comparison to work.) Groups should work independently to determine how to cut each sheet of paper. Groups then order and compare the fractions 1/5, 1/4, 1/3, 1/10 using the paper pieces they created. Extend the activity to order and compare 2/3, 2/4, 2/5, 2/10, etc. looking for multiple representations of numbers, such as 2/10 = 1/5 and ordering fraction pieces. Each group then makes a chart or table to represent what they have learned about these fractions.

Mathematics Program Outcomes: 1, 2, 3, 4, 6, 7, and 8

Quality Performance Accreditation Student Outcomes: 2, 3, and 4

Assessment Classification: Reasoning and Communication

Give each pair of students two different colored circles each with a four-inch diameter. Have the students cut a radius in each circle so the circles can be fitted together. Hold both circles in a stack in one hand with cuts on top of one another. Using your other hand, open the slits slightly, and slide the top circle until the two circles lock together. Ask each pair of students to move one of the circles so 25 percent of the other circle is showing. Have students challenge one another to make a certain fraction or decimal portion of one of the colored circle show such as, show 50 percent of the red circle or 3/4 of the white circle red. Ask students to compare other common fractions and decimals using the two circles.

Mathematics Program Outcomes: 1, 2, 3, 4, 6, and 8

Quality Performance Accreditation Student Outcomes: 2, 3, and 4

Assessment Classification: Concepts

Outcome Illustration: uses multiple representations for the same number

Represent or describe each of the following numbers in 5 different ways.

10 $4.50 36

Mathematics Program Outcomes: 3, 4, and 8

Quality Performance Accreditation Student Outcomes: 2, 3, and 4

Assessment Classification: Knowledge Base

How many different ways can you make change for a 50 cent coin without using pennies?

Mathematics Program Outcomes: 1, 2, 3, 4, and 8

Quality Performance Accreditation Student Outcomes: 2, 3 and 4

Assessment Classification: Knowledge Base

(Continued on next page.)

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Mathematics Curriculum Outcome 1

Focus Area–Number Sense and Systems

FOURTH GRADE OUTCOME:

The student develops and demonstrates number sense for whole numbers, fractions, and decimals to solve problem situations within and outside of mathematics.

Outcome Illustration: determines reasonableness of results

When Sarah filled her gas tank, she used 12.9 gallons of gas. The trip odometer reading was 254.9 miles. How many miles did her car go on each gallon of gas? (Calculator use is encouraged.) How do you know your answer makes sense?

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving and Concepts

Outcome Illustration: orders whole numbers, fractions, and decimals

Outcome Illustration: uses multiple representations for the same number

Divide your students into cooperative groups of four. Give each group four different colored rectangular sheets of paper which are the same size (4" x 10" for example). Have each group cut one sheet of paper into 5 equal parts, one sheet into 4 equal parts, one sheet into 10 equal parts and the last sheet of paper into 3 equal parts. (All cuts must be made vertical in order for comparison to work.) Groups should work independently to determine how to cut each sheet of paper. Groups then order and compare the fractions 1/5, 1/4, 1/3, 1/10 using the paper pieces they created. Extend the activity to order and compare 2/3, 2/4, 2/5, 2/10, etc. looking for multiple representations of numbers, such as 2/10 = 1/5 and ordering fraction pieces. Each group then makes a chart or table to represent what they have learned about these fractions.

Mathematics Program Outcomes: 1, 2, 3, 4, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Reasoning and Communication

Give each pair of students two different colored circles each with a four-inch diameter. Have the students cut a radius in each circle so the circles can be fitted together. Hold both circles in a stack in one hand with cuts on top of one another. Using your other hand, open the slits slightly, and slide the top circle until the two circles lock together. Ask each pair of students to move one of the circles so 25 percent of the other circle is showing. Have students challenge one another to make a certain fraction or decimal portion of one of the colored circle show such as, show 50 percent of the red circle or 3/4 of the white circle red. Ask students to compare other common fractions and decimals using the two circles.

Mathematics Program Outcomes: 1, 2, 3, 4, 6 , and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Concepts

Outcome Illustration: uses multiple representations for the same number

Represent or describe each of the following numbers in 5 different ways.

10 $4.50 36

Mathematics Program Outcomes: 3, 4, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base

How many different ways can you make change for a 50 cent coin without using pennies?

Mathematics Program Outcomes: 1, 2, 3, 4, and 8
Quality Performance Accreditation Student Outcomes: 2, 3 and 4
Assessment Classification: Knowledge Base

(Continued on next page.)

Mathematics Curriculum Outcome 1
Focus Area–Number Sense and Systems

FOURTH GRADE OUTCOME:

The student develops and demonstrates number sense for whole numbers, fractions, and decimals to solve problem situations within and outside of mathematics.

Outcome Illustration: estimates quantities using whole numbers, decimals, and simple fractions

Pick five consecutive class days to discuss the following problem situations.

Day 1 - Fill a baby food jar with macaroni. Have each student make a whole number estimate of the number of macaronies in the jar. List all the responses on the chalkboard. Discuss the range of answers, look for the mode, discuss any outliers, etc. Then count the number of macaronies in the jar one by one, or by groups of two's, five's, or ten's. Have the students reflect on what they've learned.
Day 2 - Fill a medium-sized jar with the same sized macaroni as used on day one, then repeat the process followed on day one.
Day 3 - Fill a large jar with the same sized macaroni as used on day one, then repeat the process followed on day one.
Day 4 - Fill a different shaped clear container with the same sized macaroni as used on day one, then repeat the process followed on day one.
Day 5 - Fill the container used in day four with macaroni of a different size. Repeat the estimation activities. Discuss the effect of changing the size of the macaroni and/or changing the size and shape of the container has on your estimate.
Mathematics Program Outcomes: 1, 2, 3, 4, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving, Knowledge Base, and Reasoning

Mathematics Program Outcome 2

Focus Area–Number Sense and Systems

FOURTH GRADE OUTCOME:

The student explores properties of whole numbers, fractions, mixed numbers, and decimals.

Ask the student to use colored tiles or graph paper to demonstrate why 3 x 4 = 4 x 3.
Mathematics Program Outcomes: 2, 3, 4, 6 and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Concepts

Give two students seven dimes. Ask them to count how much money each of them have. Then ask them to count how much money the two of them have together. Give seven students two dimes. Ask them to count how munch money each of them have. Then ask them to count how much money the seven of them have together. Have them write an equation to illustrate the amount each group has.
Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures

Ask the students to use base 10 blocks to determine if **(6 x 10) x 3 = 6 x (10 x 3)** is true.
Mathematics Program Outcomes: 2, 3, 4, 5, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Concepts and Procedures

Use base 10 blocks to model and explain how to solve the problems 32 x 4 and 32 x 14.
Mathematics Program Outcomes: 2, 3, 4, 5, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures

If two of your classmates each have three dimes and four nickels, demonstrate and explain two different ways to determine the total amount of money the students have.
Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures

My brother and I have 1 1/2 pizzas in the refrigerator that mom told us we could have for lunch. Aunt Margie called to invite use to lunch at her house. When Mom opened the refrigerator to fix dinner, she asked why there were still 1 1/2 pizzas left in the refrigerator. Explain what happened mathematically.
Mathematics Program Outcomes: 1, 2, 3, 4, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base

Mathematics Curriculum Outcome 3

Focus Area–Number Sense and Systems

FOURTH GRADE OUTCOME:

The student investigates counting numbers, whole numbers, fractions, mixed numbers, and decimals with a special emphasis on place value.

Outcome Illustration: models and explains the relationship among counting numbers, whole numbers, simple fractions, mixed numbers, and decimals

Pick three consecutive classroom days to discuss the following situations.

Day 1 - Construct a large number line on the floor from 1 to 10. Give cards to students with various mixed numbers on them. Ask students to position themself on the number line based on the card they are holding. Students have smaller number lines at their desk and position each number on their own number line.

Day 2 - Repeat day one's activities using decimal numbers such as 2.5. May be extended to combined mixed numbers and decimals.

Day 3 - Repeat day one's activities using whole numbers, simple fractions, mixed numbers, and decimals. Ask the student to write down five relationships between the numbers they have placed on their number line.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base, Communication, and Procedures

Outcome Illustration: understands and appreciates the need for numbers beyond the whole numbers

Have the student list real life examples of the need for fractions, such as: 1) A size 7 shoe is too tight and a size 8 shoe is too big for my foot or 2) What does it mean when someone says they have two-and-a-half dollars?

Mathematics Program Outcomes: 1, 2, 3, 4, 7, 8, and 9
Quality Performance Accreditation Student Outcomes: 2, 3, 4 and 5
Assessment Classification: Communication

Outcome Illustration: understands our numeration system by relating counting, grouping, and place-value concepts

Give each student a scoop of objects to count by grouping. Have each student give an explanation of how they grouped their objects and why that grouping was chosen.

Mathematics Program Outcomes: 2, 3, 4, 5, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base and Procedures

Have the student use base 10 blocks to illustrate how many hundreds, tens, and ones there are in the number 1,346.

Mathematics Program Outcomes: 1, 2, 3, 4, and 8
Quality Performance Accreditation Student Outcomes: 2, 3 and 4
Assessment Classification: Knowledge Base and Communication

Have the student discuss the difference between 10 and 1/10.

Mathematics Program Outcomes: 1, 2, 3, 4, and 8
Quality Performance Accreditation Student Outcomes: 2, 3 and 4
Assessment Classification: Concepts

A class is figuring the number of seeds in a jar. The number of seeds is a four-digit number that includes all the numbers 2, 3, 4, and 8. They have 3 clues to help them. Use the clues to answer the question below.

CLUE 1: The number in the one's place is odd.
CLUE 2: The number in the ten's place is half the number in the hundred's place.
CLUE 3: The number in the hundred's place is greater than the number in the one's place.

(Continued on next page)

Mathematics Curriculum Outcome 3

Focus Area–Number Sense and Systems

FOURTH GRADE OUTCOME:

The student investigates counting numbers, whole numbers, fractions, mixed numbers, and decimals with a special emphasis on place value.

Given these clues, explore all possible combinations of digits that tell the number of seeds that could be in the jar. How many seeds could be in the jar?

Mathematics Program Outcomes: 1, 2, 3, 4, and 8

Quality Performance Accreditation Student Outcomes: 2, 3 and 4

Assessment Classification: Problem Solving and Knowledge Base

Mathematics Curriculum Outcome 4

Focus Area–Number Sense and Systems

FOURTH GRADE OUTCOME:

The student explains, models, and performs operations with whole numbers to solve problem situations within and outside of mathematics. The student explores operations with fractions, mixed numbers, and decimals.

Outcome Illustration: selects and performs appropriate whole number estimation and computation

Luis wants to buy a dirt bike that costs $180 (not including tax). He earns $2.00 an hour babysitting. He has saved $65. About how many more hours will he need to work?

Mathematics Program Outcomes: 1, 2, 5, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3 and 4
Assessment Classification: Problem Solving and Procedures

Outcome Illustration: selects and uses appropriate computational tools

Outcome Illustration: develops and explains computational procedures and estimation strategies

Would you use mental math, paper and a pencil, or a calculator to solve the problems listed below? Why did you choose the method you did?

a. It takes 1 1/2 jars of paint to paint each model car blue. My two brothers and I each want to paint a car. How many jars would we buy?
b. You have $79. You spend $34 on tennis shoes. How much is left to pay for a new jacket?
c. Sarah has 1,246 baseball cards. Her album holds 12 cards per page. How many pages does she need to buy?
d. How many blocks is it from your school to the nearest gas station?

Mathematics Program Outcomes: 1, 2, 3, 5, 6, 8, and 9
Quality Performance Accreditation Student Outcomes: 2, 3, 4, and 5
Assessment Classification: Procedures

Jack likes to multiply numbers in order. He likes multiplication sequences like:

1 x 2 x 3 x 4 = 24 5 x 6 = 30
4 x 5 x 6 = 120

Using only the numbers 1 through 9 and working with your calculator, write the multiplication sequence for the product 1,680. Write the multiplication sequence in order and show the answer.

Mathematics Program Outcomes: 1, 2, 3, 5, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving and Reasoning

Outcome Illustration: uses estimation to check reasonableness of results

Add the numbers:
427
139
85
513
+ 652

Use an estimation strategy to check your work. Explain why you chose this estimation method.

Mathematics Program Outcomes: 1, 2, 3, 5, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures and Knowledge Base

Examples of estimation strategies:
a. (Front-end with Adjustment)
$1.26
4.79 Add whole number part (left-most digit)
.99 1 + 4 + 0 + 1 + 2 = 8
1.37 Adjust by looking at decimal parts
2.58 .26 + .79 = 1
.99 = 1
.37 + .58 = 1
3

Therefore, the estimate is 8 + 3 = 11

(Continued on next page)

Mathematics Curriculum Outcome 4

***Focus Area–Number Sense* and Systems**

FOURTH GRADE OUTCOME:

The student explains, models, and performs operations with whole numbers to solve problem situations within and outside of mathematics. The student explores operations with fractions, mixed numbers, and decimals.

b. (Rounding)

$4.78
2.93 Round number to nearest whole number
1.25
3.12 5 + 3 + 1 + 3

Therefore, the estimate is 12

c. (Special Numbers)

Examples of special numbers are 1, 10, 100, 1,000, 1/2, 0

Estimate by rounding to one of the special numbers.

67 x 102 Estimate 67 x 100 or 6,700

5,421 / 9.87 Estimate 5,421 / 10 or 542.1

4/7 + 12/13 Estimate 1 + 1/2 or 1 1/2

4,805 x 11/21 Estimate 4805 x 1/2 or 2,400

d. (Clustering)

Clustering can be used as an estimation strategy when you have a group of numbers that cluster common value.

7225
6734 This set of numbers clusters around 7,000.
6829 A good estimate would be 7000 x 6 or 42,000.
7,295
7101
+ 6,642

e. (Compatible "nice" Numbers)

Compatible (nice) numbers are numbers that can easily "fit together" and are easy to manipulate mentally. Take a global look at all numbers, look for numbers that can be paired for easy computation.

27
49 27 + 81 = 100
38 49 + 56 = 100
56 38 + 65 = 100
81
+ 65 Therefore, the estimate is 300.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 8, and 9

Quality Performance Accreditation Student Outcomes: 2, 3, 4, and 5

Assessment Classification: Procedures and Knowledge Base

Mathematics Curriculum Outcome 5

Focus Area–Patterns, Functions, Algebraic Concepts, and Relationships

FOURTH GRADE OUTCOME:

The student recognizes, describes, extends, develops, and explains the relationships in a wide variety of patterns from problem situations within and outside of mathematics.

Consider the following set of numbers. List all of the patterns you can find.

9
18
27
36
45
54
63
72
81

Mathematics Program Outcomes: 2, 3, 4, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Reasoning and Knowledge Base

Beth brings an apple for lunch 1 out of every 5 days each school week. About how many days will she bring an apple for lunch in April?

Mathematics Program Outcomes: 1, 2, 3, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving and Reasoning

Using two different colored cubes or tiles, have the students generate and record patterns. Have students extend patterns, record patterns, and describe the pattern.

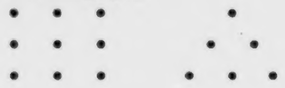
Example

Yellow	Green
1	3
2	6
•	•
•	•
•	•
•	•
•	•
7	21

Mathematics Program Outcomes: 1, 2, 3, 4, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Communication

Using beans, have students make a model for square numbers and triangular numbers by gluing beans to stiff paper.

Example:



Have students describe patterns they see as the size of the square or triangle increases.

Mathematics Program Outcomes: 1, 2, 3, 4, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Reasoning and Communication

Pick a day of the month to start observing the moon. Every 5 days make a drawing of the shape of the moon. Write an observation for what you see. Do this for 60 days. If it's cloudy, predict what the moon would have looked like.

Mathematics Program Outcomes: 1, 2, 3, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures and Reasoning

What is the smallest counting number you can find that has 6 different factors?

Mathematics Program Outcomes: 1, 2, and 8
Quality Performance Accreditation Student Outcomes: 3 and 4
Assessment Classification: Knowledge Base

Have students perform an experiment with one ball (tennis, table tennis, racquet, etc.). Collect data by having the students record the height the ball bounces from drop heights of 40, 80, 160, 200 (cm). Build a graph or a chart to predict the bounce height at 120 and 240 cm.

Mathematics Program Outcomes: 1, 2, 3, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving, Communication and Procedures

(Continued on next page.)

Mathematics Program Outcome 5

Focus Area–Patterns, Functions, Algebraic Concepts, and Relationships

FOURTH GRADE OUTCOME:

The student recognizes, describes, extends, develops, and explains the relationships in a wide variety of patterns from problem situations within and outside of mathematics.

Joshua, Charlene, Andrea, and Kurtis are playing video games. Make a diagram or drawing to show how many games they will play if each person must play with everyone else one time. What other ways could be used to model the problem?
Mathematics Program Outcomes: 1, 2, 3, 5, 6, 8, and 9
Quality Performance Accreditation Student Outcomes: 2, 3, 4, and 5
Assessment Classification: Problem Solving and Procedures

With students working in pairs, have the first student pick a number less than 10 and input it into a calculator. Push the + key and the = key and the = key one more time. Pass the calculator to their partner. The partner pushes the = key at least two times. The first student tries to determine what number will be on the calculator screen.
Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Concepts and Knowledge Base

You are arranging twelve rectangular tables for a party. Using 12 colored tiles or an appropriate manipulative, make as many different table arrangements as possible. (Edges must touch in a straight line. Make a record of your arrangements. If you want to seat 24 people, what is the least number of tables you can use. Draw a sketch of this arrangement.
Extension 1: Write a letter to a friend telling them what you did.
Extension 2: Use you findings from the problem to predict how you would arrange tables to seat 36 people using the least number of tables.
Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6 ,7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving, Reasoning, Communication, and Knowledge Base

For one month keep track of the temperature at a specific time of day, (i.e., break, lunch, recess, etc.). Record your information in a graph. Have students predict the temperature before it's reported. Discuss predictions, trends, etc.
Mathematics Program Outcomes: 1, 2, 3, 4 , 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving and Communication

Cut 5 different colors of construction paper into 3" by 18" strips. Choose a different color to make pieces representing 1, 1/2, 1/4, 1/8, and 1/16. Students are to fold and cut or tear strips into these sizes. Be sure to label each piece appropriately. Students use their fraction kits to order and compare fractions. Have students record their observations.
Extension 1: Design a game to cover and uncover fractional pieces of 1.
Extension 2: Put several kits together and have students add numbers using the least number of pieces. For example, 1 3/8 + 1 1/4. Students will change 2/8 for 1/4.
Note: We are not suggesting that students do this with pencil and paper! This is only exploratory.
Mathematics Program Outcomes: 2,3, 4, 5, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Concepts and Procedures

Mathematics Program Outcome 6

Focus Area–Patterns, Functions, Algebraic Concepts, and Relationships

FOURTH GRADE OUTCOME:

The student explores the concept of function.

Outcome Illustration: makes generalizations about patterns

Sally is having a party. The first time the doorbell rings one guest enters. If on each successive ring a group enters that has 2 more persons than the group that entered just before, how many guests will have arrived after the 20th ring?

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving and Procedures

Use the chart of data to write a mathematical relationship between X and Y for the data.

X	Y
1	4
3	6
7	10
8	11
2	5

Mathematics Program Outcomes: 1, 2, 3, 4, 5, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Reasoning, Knolwedge Base and Communication

Outcome Illustration: uses letters and symbols to describe relationships

Solve for A:

$A \times 2 = 4$
$A \times 3 = 6$
$A \times 4 = 8$
$A \times 5 = 10$

Draw a picture for each relationship.

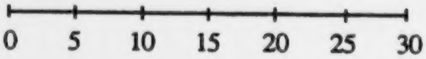
Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Concepts and Communication

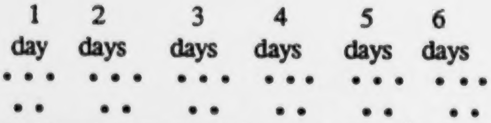
Peggy must swim 30 kilometers in 6 days to qualify for the team. If she swims the same distance each day, how far must she swim each day?

Note: Students need to see the connection of a variety of solutions.

$6 \times n = 30$

$30 / 6 =$ ___





Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures and Knowledge Base

Outcome Illustration: recognizes and uses appropriate terminology to describe functions

Complete this input table

3	9	5	8	1	6
7	13	9			10

Write a math number sentence to describe the relationship.

Mathematics Program Outcomes: 1, 2, 3, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knolwedge Base and Communication

Mathematics Curriculum Outcome 7

Focus Area–Patterns, Functions, Algebraic Concepts, and Relationships

FOURTH GRADE OUTCOME:

The student uses whole number equations and inequalities to solve problem situations within and outside of mathematics. The student explores simple equations and inequalities involving fractions, mixed numbers, and decimals.

Outcome Illustration: uses symbols for unknown quantities

Outcome Illustration: writes and solves simple equations

Solve: $7 + 6 = 10 + \square$

$\square = 7 \times 4$

$\square + 9 + 7 = 20$

$A + 7 = 14$

$x + 12 = 18$

$P = 42 - 7$

Mathematics Program Outcomes: 1, 2, 3, 4, 5, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base and Communication

Outcome Illustration: writes and solves simple equations

Write an equation to show how many days are in 96 hours. Solve this equation.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3 and 4
Assessment Classification: Knowledge Base

Pistol Pete buys a horse for $50.00, sells it for $60.00, buys it back for $70.00, and sells it again for $80.00. How much money did he gain or lose on these deals?

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3 and 4
Assessment Classification: Reasoning and Communication

Mathematics Curriculum Outcome 8

Focus Area–Patterns, Functions, Algebraic Concepts, and Relationships

FOURTH GRADE OUTCOME:

The student develops and uses models to represent and justify mathematical relationships and to assist in the solution of problem situations within and outside of mathematics.

Ask the students to use base 10 blocks to determine if $(6 \times 10) \times 3 = 6 \times (10 \times 3)$ is true.

Mathematics Program Outcomes: 2, 3, 4, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Concepts and Procedures

Pick three consecutive classroom days to discuss the following situations.

Day 1 - Construct a large number line on the floor from 1 to 10. Give cards to students with various mixed numbers on them. Ask students to position themself on the number line based on the card they are holding. Students have smaller number lines at their desk and position each number on their own number line.

Day 2 - Repeat day one's activities using decimal numbers such as 2.5. May be extended to combined mixed numbers and decimals.

Day 3 - Repeat day one's activities using whole numbers, simple fractions, mixed numbers, and decimals. Ask the student to write down five relationships between the numbers they have placed on their number line.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base, Communication, and Procedures

Pick a day of the month to start observing the moon. Every 5 days make a drawing of the shape of the moon. Write an observation for what you see. Do this for 60 days. If it's cloudy, predict what the moon would have looked like.

Mathematics Program Outcomes: 1, 2, 3, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures and Reasoning

Using a computer drawing program have the students draw a shape and then identify the number of sides and the number of angles in the shape.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base

The students are given 24 cubes. Using the cubes, they are to design as many rectangular prisms — called apartments, as possible such as 3 x 4 x 2 prism. Their designs can be drawn on graph paper. Students will identify certain basic shapes with different foundations. Students sketch the view from the top, front, and side to show what the apartment looks like. This problem can be modified by increasing the number of cubes used.

Mathematics Program Outcomes: 1, 2, 3, 4, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base

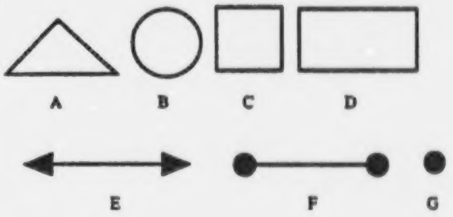
Mathematics Curriculum Outcome 9

Focus Area–Geometry and Spatial Sense

FOURTH GRADE OUTCOME:

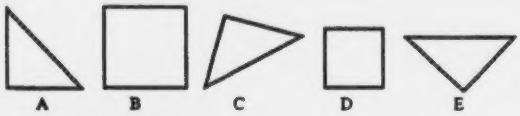
The student recognizes and investigates properties of simple geometric figures using appropriate technology, manipulatives, or constructions.

Given the figures



a. Which figure is a square?
b. Which figure is a line segment?
c. Which figure is a triangle?

Mathematics Program Outcomes: 3, 4, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base

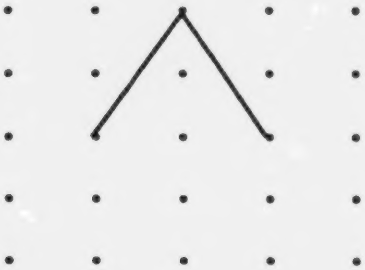


Given the figures

a. Which figures are similar?
b. Which figures are congruent?

Mathematics Program Outcomes: 3, 4, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base

Have students do problems similar to this one on the geoboard.



This is part of a closed figure. Complete the figure so it has two lines of symmetry.

Mathematics Program Outcomes: 1, 2, 4, 5, and 8
Quality Performance Accreditation Student Outcomes: 3 and 4
Assessment Classification:

Students feel an object inside a paper bag. They are to identify the object and then create that object on the geoboard or a piece of paper. Use a variety of different shapes (pattern blocks) so that students have many opportunities to do this. Students could also orally describe the object they feel or they could write a description of the object.

Mathematics Program Outcomes: 2, 3, 4, 6, 8, and 9
Quality Performance Accreditation Student Outcomes: 2, 3, 4, and 5
Assessment Classification: Concepts and Communication

Place a three-dimensional object in a paper sack. Students feel the object inside the bag and identify the object. Use a variety of different objects. Students could describe which attributes of the object helped them identify what is in the bag. Extension: Students could work in groups or with a partner. One student could have the "mystery figure." Other students take turns asking about properties of the figure. For example: Are the sides parallel? How many faces are there? Are the angles right angles? Are the angles less than 90°? Are the angles greater than 90°?

Mathematics Program Outcomes: 1, 2, 3, 4, 6, and 8
Quality Performance Accreditation Student Outcomes: 3, 4, and 5
Assessment Classification: Concepts and Knowledge Base

(Continued on next page.)

Mathematics Curriculum Outcome 9

Focus Area–Geometry and Spatial Sense

FOURTH GRADE OUTCOME:

The student recognizes and investigates properties of simple geometric figures using appropriate technology, manipulatives, or constructions.

Give students a 5 x 5 pin geoboard and have them construct a figure with:

no right angles;
exactly two right angles;
six right angles;
as many right angles as possible.

Mathematics Program Outcomes: 1, 2, 3, 4, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Reasoning and Knowledge Base

With a partner the student writes at least 3 properties of a shape to be formed on a geoboard. The written descriptions are exchanged and each student forms a shape that meets the other's criteria.

Mathematics Program Outcomes: 1, 2, 3, 4, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Communication and Concepts

Give the student a 3-dimensional shape such as a cube, rectangular prism, or triangular prism, along with, paper, scissors, and tape. The student is asked to create the outer shell of the shape. Have students show the faces, edges, and vertices. The paper creates a net when it is flattened out. Have the students investigate different ways that a net can be created for some of the shapes.

Mathematics Program Outcomes: 1, 2, 3, 4, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Concepts and Communication

A variety of three-dimensional figures, including cube, rectangular prism, sphere, or cones should be available. Working with a partner, a student describes a figure and the other student guesses what it is. Students should describe the figure in such a way that the object can be correctly identified with the minimum number of guesses.

Example: The figure has 6 faces.
All faces have the same size and shape.
All angles are congruent.

Mathematics Program Outcomes: 1, 2, 3, 4, 6 and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Communication and Knowledge Base

Using a computer drawing program have the student draw a simple picture or a shape that is composed of a certain number of line segments and a specified number of angles.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base

Using a computer drawing program have the students draw a shape and then identify the number of sides and the number of angles in the shape.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base

(Continued on next page.)

Mathematics Curriculum Outcome 9

Focus Area–Geometry and Spatial Sense

FOURTH GRADE OUTCOME:

The student recognizes and investigates properties of simple geometric figures using appropriate technology, manipulatives, or constructions.

Working with a partner, one student describes an geometric figure and the other person guesses what it is. Students should give clues in such a way that the object could be identified or determined with the minimum number of guesses.
Example: The figure has 4 sides.
All sides are equal.
All angles are equal.
All angles are 90 degrees.

Mathematics Program Outcomes: 1, 2, 3, 4, 6, 8, and 9
Quality Performance Accreditation Student Outcomes: 2, 3, 4, and 5
Assessment Classification: Communication and Knowledge Base

Have the students sort block style letters into letters that have no symmetry, one line of symmetry, two lines, of symmetry or more. Have students find words that have one line of symmetry, such as T A T.

Mathematics Program Outcomes: 1, 2, 3, 4, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Concepts and Reasoning

Mathematics Curriculum Outcome 10

Focus Area–Geometry and Spatial Sense

FOURTH GRADE OUTCOME:

The student uses estimation and measurement involving standard and non-standard units to solve problem situations within and outside of mathematics.

Outcome Illustration: describes attributes of common two dimensional figures

With each student working in pairs have students sit back to back. Give each student a square, triangle, rhombus, hexagon, parallelogram, and trapezoid (pattern blocks work well). Student A selects one shape to describe. Student B listens and eliminates the ones not having the attributes described (excluding color).

Variation - Student A asks questions that have yes or no answers of student B to determine the unknown piece.

Example: Does your shape have more than three sides?

Are the sides equal?

Are the angles 90°?

Mathematics Program Outcomes: 1, 2, 3, 4, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Communication and Knowledge Base

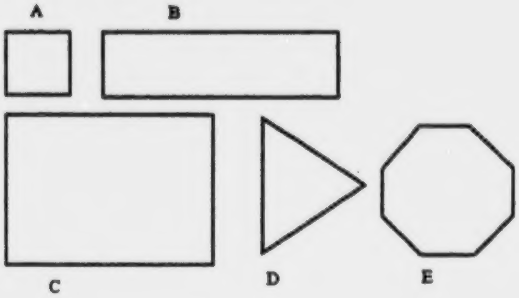
Using your geoboard, form a square having 2 pegs on a side? How many pegs on a side. How many pegs are enclosed? Form a square having 3 pegs on a side? How many pegs are enclosed? Continue this process until you can determine a pattern between the number of pegs on the side and the number of pegs enclosed.

Mathematics Program Outcomes: 1, 2, 3, 4, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Reasoning

Draw four different rectangles that have a perimeter of 24.

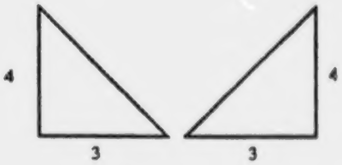
Mathematics Program Outcomes: 1, 2, 3, 4, 5, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures and Knowledge Base

Which figure has the largest perimeter? Explain how you arrived at your answer.



Mathematics Program Outcomes: 1, 2, 3, 4, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3 and 4
Assessment Classification: Knolwedge Base

Study the two triangles below, then answer parts (a), (b), and (c).



a. Using sentences, diagrams, or illustrations, tell how you would determine the total area of the two triangles.
b. What is the total area for the two triangles?
c. What is the area of one of the triangles?

Mathematics Program Outcomes: 1, 2, 3, 4, 2, 3, and 5
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures and Reasoning

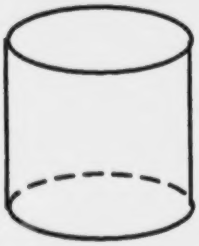
Mathematics Curriculum Outcome 10

Focus Area–Geometry and Spatial Sense

FOURTH GRADE OUTCOME:

The student uses estimation and measurement involving standard and non-standard units to solve problem situations within and outside of mathematics.

You are estimating the number of pennies that a 1 gallon paint can will hold. You have only 1 cupful of pennies. Tell how you would go about making a reasonable estimate of the number of pennies the gallon paint can will hold. Next, you have an empty can of unknown size. It is shaped like the illustration below. Again you have only 1 cupful of pennies. You want to estimate the number of pennies this container will hold. Explain how you would do this.



Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7 and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures and Reasoning

Outcome Illustration: selects appropriate measurement tools, appropriate units of measurement, and appropriate degrees of accuracy

Which of these would be the best to use when measuring the length of the hallways in your school?

a. centimeter ruler
b. meter stick
c. protractor
d. measuring tape
e. string

Defend your selection.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base

After students have had experience using gram weights and a balance scale, ask them to give examples of items they would measure using grams, kilograms, and metric tons.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base

Give each student a sheet of centimeter graph paper. Have them estimate the area of their foot by tracing around their shoe on the graph paper and counting the squares. (Students will have to decide how to count squares which are only partially included.)

Mathematics Program Outcomes: 1, 2, 4, 5, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures

If after taking your temperature with a thermometer your temperature is 103°, would you round to 100°? Why or why not?

Mathematics Program Outcomes: 1, 2, 3, 5, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Reasoning and Procedures

If a pencil is 1 7/8 inches long, would you estimate its length to 2"? Why or why not?

Mathematics Program Outcomes: 1, 2, 3, 5, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Reasoning and Procedures

Mathematics Curriculum Outcome 11

Focus Area–Geometry and Spatial Sense

FOURTH GRADE OUTCOME:

The student relates geometric and measurement concepts to numbers to solve problem situations within and outside of mathematics.

Examine a rectangular box.

a. How tall is the box?
b, How wide is the box?
c. What is the area of the top of the box? (Hint: use grid paper)
d. How much will the box hold? (Hint: use unit cubes)

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base and Reasoning

Using a geoboard, have the students create a square that is one unit on a side. Have students determine the perimeter of the square. Have students increase the side length by one unit and describe what happens to the perimeter.

Extension: Have the student describe what happens to the area as the sides increase by one unit.

Mathematics Program Outcomes: 1, 2, 3, 4, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Reasoning and Communication

The students are to figure the area of their foot or hand.

a. Trace around foot (hand) on squared centimeter paper.
b. Figure the area of hand or foot in square centimeters.
c. Write a letter to a friend describing how you figured the area of your foot (hand).

Extension: Measure height. Make a graph showing the correlation between a student's height and the area of their foot (hand). Have students make predictions or conjectures about this correlation.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures, Knowledge Base, and Communication

Give the student several rectangular containers a number of cubes. Have the students estimate the number of cubes each container will hold and then check their estimate using the cubes to fill the containers, students should record their estimates as well as the actual number of cubes used to fill the containers.

Mathematics Program Outcomes: 1, 2, 3, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures

The students are given 24 cubes. Using the cubes they are to design as many rectangular prisms — called apartments, as possible such a 3 x 4 x 2 prism. Their designs can be drawn on graph paper. Students identify basic shapes with different foundations. Students sketch the views from the top, front, and sides. This problem can be modified by increasing the number of cubes used.

Extension: Have students use their partners sketches to construct an apartment.

Mathematics Program Outcomes: 1, 2, 3, 4, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Concepts and Knowledge Base

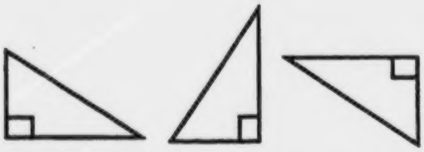
Mathematics Curriculum Outcome 12

Focus Area–Geometry and Spatial Sense

FOURTH GRADE OUTCOME:

The student recognizes and explores transformations of basic geometric figures to solve problem situations within and outside of mathematics.

What would be the next shape in the following pattern?



Mathematics Program Outcomes: 1, 2, 3, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Reasoning

Paint or color one face of a cube. Show students what happens to the painted face when the cube is turned and flipped in different directions. In groups have students take turns rolling their cubes and writing instructions (in terms of turns and flips) for other groups to follow in order to move the cube from the original position to the new position. See if one group can follow another group's directions.

Mathematics Program Outcomes: 1, 2, 3, 4, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Communication and Reasoning

Have the students describe how transformations can affect daily life. Example: You walk into a building and find an arrow pointing downstairs. Someone had flipped it over — you should have gone upstairs.

Mathematics Program Outcomes: 1, 2, 3, 4, 7, 8, and 9
Quality Performance Accreditation Student Outcomes: 2, 3, 4, and 5
Assessment Classification: Procedures and Communication

When a pancake is cooked on one side and you are ready to continue cooking it, what transformation takes place?

Mathematics Program Outcomes: 1, 2, 3, 4, 7, 8, and 9
Quality Performance Accreditation Student Outcomes: 2, 3, 4, and 5
Assessment Classification: Procedures

Give the students a piece of paper (suggest a square) and have the students create an object or a design by "nibbling," taking off one side and adding it to the opposite side. When the student has created a shape, give the student a strip of adding machine paper and have them create a "border" by tracing the shape and sliding it along the adding machine paper. A second border can be created by flipping the shape after each tracing.

Mathematics Program Outcomes: 4, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 3 and 4
Assessment Classification: Concepts and Problem Solving

Mathematics Curriculum Outcome 13

Focus Area–Probability and Statistics

FOURTH GRADE OUTCOME:

The student explores chance and counting techniques.

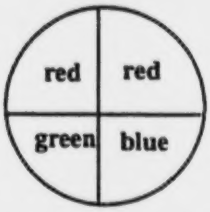
Outcome Illustration: conducts simple experiments and simulations

Put 4 different colored objects in a bag. Have each student make their own recording chart and then predict which color will be drawn most frequently in 25 draws. Each student should then draw out an object and record 25 results. In groups of 4, combine the data. Since there are 100 draws, it would be easy to relate results to percentages. Have a class discussion comparing results from various groups. Make graphs of individual group and class results. Have students write two things they have learned from the experiment.

Mathematics Program Outcomes: 1, 2, 3, 4, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving, Communication, Reasoning and Concepts

Outcome Illustration: compares experimental results with expected results

Divide a spinner into 4 sections with 1/2 marked by one color, 1/4 marked by another color, and 1/4 a third color. (This can be as simple as a paper clip revolving around a pencil point on a student-made circle.)



Have student predict which color the spinner will land on most often. After each child make their own recording device. Each child spins 25 times and records results. In groups of 4 combine the data. (Since there are 100 spins, it would be easy to relate to percentages.) Have a class discussion comparing results for various groups. Make graphs of individual group and class results. Have students write two things they have learned from the experiment if results with their prediction.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving, Communication, Reasoning, Procedures and Concepts

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Use 2-color counters. Working in pairs or with a group of four, have students place a counter in a cup, shake the cup, and pour it out. Record your results 20 times. The probability for red is 1/2. The probability for yellow is 1/2. So students would expect to get 10/20 red and 10/20 yellow. Record each group's results. Have students discuss why their results may be different from the expected results. Discuss or brainstorm what students could do to make their results to more accurately approximate their expected results.

Mathematics Program Outcomes: 1, 2, 3, 4, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving, Reasoning, and Concepts

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List some real life situations such as:
eating lunch today;
finding a purple cow in lunchroom;
having music class today.

Have the students categorize these events as a) likely, b) not very likely, and c) impossible. Have students create situations in which the outcomes fall into one of the three categories.

Mathematics Program Outcomes: 1, 2, 3, 4, 7 and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base and Concepts

Mathematics Curriculum Outcome 14

Focus Area–Probability and Statistics

FOURTH GRADE OUTCOME:

The student collects, reads, and interprets data from problem situations within and outside of mathematics.

Outcome Illustration: models, calculates, and explains the mean, median, mode, and range

Have students work in groups of 6 to 8. Each student shows the number of persons in their family by stacking cubes in a tower. Order the towers from the smallest to largest and determine the range by using the smallest and largest towers. Use the middle tower to determine median and use the most common tower size to determine the mode. Equalize the height of the towers to determine mean.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Concepts and Problem Solving

Outcome Illustration: displays data in a variety of formats

Conduct a survey of favorite animals by giving persons five choices. Display the results in bar graph (horizontal and vertical), a representational graph, a line graph, a pictograph, a chart, or a table. Each child can make a different graph; each group can make a single graph, or each group could make all the types of graphs. Repeat similar surveys on various days to give each student an opportunity to experience each type of graph. Use unifix cubes to make a representational graph. Discuss which graph presents the information in the clearest way for the information you want to present.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, 8, and 9
Quality Performance Accreditation Student Outcomes: 2, 3, 4, and 5
Assessment Classification: Problem Solving, Communication, and Reasoning

The principal asked the fourth grade students to bring old newspapers to school for a recycling project. Each student wrote the number of pounds of newspapers brought on the board. Here are the number of pounds of newspapers brought by each of the different students in the class.

23	24	27	25	26	26	28	31
24	30	25	26	26	27	27	29
26	27	25	33	28	26	25	24

Organize these numbers by making a graph. It may be a line graph, a bar graph, a circle graph, or a picture graph. You may choose the type of graph you want to draw. Label and title your graph.

Mathematics Program Outcomes: 1, 2, 3, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Communication, Procedures, and Problem Solving

Mathematics Curriculum Outcome 15

Focus Area–Probability and Statistics

FOURTH GRADE OUTCOME:

The student uses data analysis, statistics, and probability to make decisions and predictions.

Give students a cube with a star on three sides, a square on two sides, and a circle on one side. Ask students to look at the cube and list all possible outcomes and to predict which shape will appear most often. The students are to toss the cube 50 times and keep a record of their results. Make a written report of results. Extension: Students change the cube so that there are 2 stars, 2 squares, and 2 circles and repeat the experiment.

Mathematics Program Outcomes: 1, 2, 3, 4, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Reasoning, Procedures, and Communication

Using the data from the footprint/area problem from Outcome 10 display the data for about 3/4 of the class. Have the students predict about where the remaining students would be placed.

Mathematics Program Outcomes: 1, 2, 3, 4, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Reasoning and Communication

Jason said to his mother they always seemed to have the same dinner. His mother said, "That's not true. Just using four meats and four vegetables, I can make different meals each night for at least two weeks." Using the following list of four meats and four vegetables, decide if Jason's mother is correct.

Meats	Vegetables
Chicken	Carrots
Beef	Beans
Fish	Corn
Turkey	Peas

Mathematics Program Outcomes: 1, 2, 3, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures and Problem Solving

There is only one red marble in each of three bags. Without looking, you are to pick a marble out of one of the bags. Which bag would give you the greatest chance of picking the red marble? Explain your answer.

a. Bag with 10 marbles
b. Bag with 100 marbles
c. Bag with 1000 marbles
d. It makes no difference
e. I don't know

Mathematics Program Outcomes: 1, 2, 3, 4, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base and Concepts

Find the length of each of five of your classmates shoes. Make a chart of this data. Find the average length of the shoes. Use your data to make predictions of the average length of shoes for the kindergarten class and the fifth grade class.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving and Reasoning

Mathematics Curriculum Outcome 1

Focus Area–Number Sense and Systems

EIGHTH GRADE OUTCOME:

The student develops and demonstrates number sense for rational numbers to solve problem situations within and outside of mathematics.

Outcome Illustration: determines reasonableness of results

How much milk does your family drink in a day? a week? a month? a year?
Mathematics Program Outcomes: 1, 2, 4, 5, 6, and 8
Quality Performance Accreditation Student Outcomes: 3, and 4
Assessment Classification: Procedures and Knowledge Base

How much money would you and your friend need if you plan to go to a movie and buy a snack?
Mathematics Program Outcomes: 1, 2, 4, 7, and 8
Quality Performance Accreditation Student Outcomes: 3, and 4
Assessment Classification: Knowledge Base

Which of the following numbers most appropriately represents the population of the state of Kansas?

a. 200,000 b. 170,000,000 c. 1,500,000
Mathematics Program Outcomes: 1, 2, 4, 7, and 8
Quality Performance Accreditation Student Outcomes: 3, and 4
Assessment Classification: Knowledge Base and Reasoning

Of the following, which would be appropriate for the miles per gallon average for a Ford Taurus?

a. 3 mpg b. 30 mpg c. 300 mpg d. 3,000 mpg
Mathematics Program Outcomes: 1, 2, 4, 7, and 8
Quality Performance Accreditation Student Outcomes: 3, and 4
Assessment Classification: Knowledge Base and Reasoning

Kim was having a birthday party. She went to the store and bought 3 3/4 pounds of hamburger at $1.29 a pound. The clerk ran it over the scanner and the total was $48.38. Should Kim pay this amount? Why or why not?
Mathematics Program Outcomes: 1, 2, 3, 5, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures and Reasoning

What does it mean when the weather forecasts says there is a 30 percent chance of rain?
Mathematics Program Outcomes: 1, 2, 3, 4, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Concepts and Communication

Can someone really give a 110 percent effort?
Mathematics Program Outcomes: 1, 2, 3, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Reasoning

Sarah's calculator showed the answer 676.8 after she multiplied 9.4 x 7.2. Her estimate suggested the answer should be about 9 x 7 or about 63. What did she do wrong?
Mathematics Program Outcomes: 1, 2, 3, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Reasoning

(Continued on next page.)

Mathematics Curriculum Outcome 1

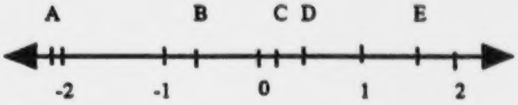
Focus Area–Number Sense and Systems

EIGHTH GRADE OUTCOME:

The student develops and demonstrates number sense for rational numbers to solve problem situations within and outside of mathematics.

Outcome Illustration: develops and uses order relations for whole numbers, fractions, decimals, integers, and rational numbers

Given the figure below:



Compare the values of the labeled points on the number line above. Would it be better to label the points numerically with decimal or fractions? Why? Name the number represented by C? B? A? D? E?

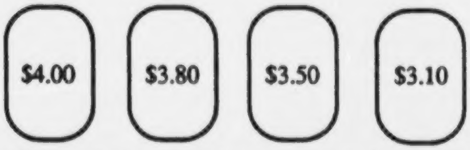
Mathematics Program Outcomes: 1, 2, 3, 4, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base

Place the following numbers in order from smallest to largest.

3/4, -3, 3.2, 2 x 10^3, 200, 230%, 2 1/2, .002, 2%, 3.4, -3.2

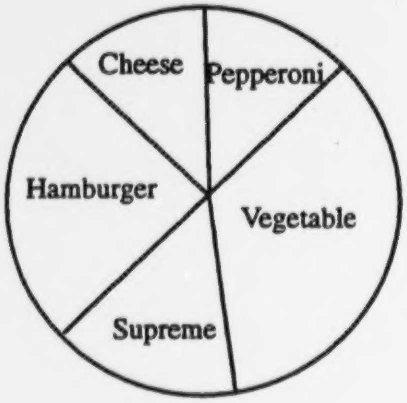
Mathematics Program Outcomes: 1, 2, 3, 4, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base

Write money amounts on 5 x 8 index cards. Give a card to each student in the class. Students are to order from the least amount of money to the greatest amount of money, holding cards so that everyone can see them.



Mathematics Program Outcomes: 1, 2, 3, 4, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base

Outcome Illustration: uses multiple representations for the same rational number



A student survey was taken at Jacksonville High School to determine student preferences for their favorite pizza topping. The results are shown in the graph above. What percent of the students prefer vegetable? hamburger? If 632 students were surveyed, approximately how many students prefer supreme? What fractional number represents the students who prefer cheese or pepperoni? Represent the students who chose pepperoni by using a decimal number? percent? fraction?

Extension - Take a survey of your classmates preferences for the toppings shown in the graph. Make your own graph and include a narrative comparing your results with the original graph and discuss why your local pizza company would be interested in your results.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, 8, and 9
Quality Performance Accreditation Student Outcomes: 2, 3, 4, and 5
Assessment Classification: Communication and Problem Solving

(Continued on next page.)

Mathematics Curriculum Outcome 1
Focus Area–Number Sense and Systems

EIGHTH GRADE OUTCOME:

The student develops and demonstrates number sense for rational numbers to solve problem situations within and outside of mathematics.

Write the number 2 1/4 in five different ways.
Mathematics Program Outcomes: 3, 4, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base

Outcome Illustration: estimates quantities using rational numbers

In groups of four, students are to estimate the average wind chill during the month of January at a given time of day. Begin by having the students read the daily temperature and measure the speed of the wind. Estimate the wind chill using a wind chill chart from the National Weather Bureau and record the information using a method of their choice. Have the students interpret the statistical meaning of the data (i.e., mean, median, mode, and range). Display this information with graphs, charts, or tables.
Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving, Procedures, Knowledge Base and Communication

Place a pile of nickels on a desk. Ask students to estimate the number of dollars in the pile. Repeat with dimes, then quarters, then a mixture of nickels, dimes, and quarters.
Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base and Procedures

Your parents have agreed to pay the costs for you and a friend to attend a major league baseball game in Dallas, Texas. You will spend two nights in Dallas. Prepare a list of expenses and estimated costs that you will present to your parents. Show the estimated total dollars needed for the trip. Discuss why it could be important to estimate the cost of any trip you might plan to take.

Expense Items	Estimated Cost
____________	____________
____________	____________
____________	____________
____________	____________
Total Estimated Cost:	____________

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, 8, and 9
Quality Performance Accreditation Student Outcomes: 2, 3, 4, and 5
Assessment Classification: Problem Solving, Reasoning, and Knowledge Base

Mathematics Curriculum Outcome 2

Focus Area–Number Sense and Systems

EIGHTH GRADE OUTCOME:

The student recognizes, applies and explains properties of the rational number system and its operations.

A practical way to illustrate the importance of rational number properties is to use them in mental math activities where calculations become easier when numbers are rearranged or regrouped.

Example: Using mental math, find the total cost of a meal, including a 15 percent tip, for each of the following meals.

Menu

Item 1	$2.12
Item 2	1.35
Item 3	1.88
Item 4	2.97

Meal A: Items 1, 3, & 4
Meal B: Items 1, 2, & 3
Meal C: Items 2 & 4

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 8, and 9
Quality Performance Accreditation Student Outcomes: 2, 3, 4, and 5
Assessment Classification: Problem Solving and Knowledge Base

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Divide the class into groups of four. Assign each group a property to model for the class by using only their physical selves and whatever props they need for the cases they find to be difficult. (Example: a student can represent a 0 or a 1 when doing identities, but the "opposite of me" can be more difficult.) Have the students model their properties in the class. Discuss why the model is or is not appropriate.

Have the students illustrate their model using magnetic numbers and signs.
Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Concepts and Communication

Use models to demonstrate if the communative property holds for each of the four operations, multiplication, division, addition, and subtraction.
Mathematics Program Outcomes: 1, 2, 3, 4, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Concepts and Reasoning

Pam wanted to calculate $(40+20+5)/5$ on her calculator. She pressed 40 $\boxed{+}$ 20 $\boxed{+}$ 5 $\boxed{\div}$ 5 $\boxed{=}$ and got 61. Is that a reasonable answer? Justify your answer using mathematical properties. If the answer is not reasonable what can Pam do with her calculator to find a reasonable answer?
Mathematics Program Outcomes: 1, 2, 3, 5, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Reasoning and Procedures

Mathematics Curriculum Outcome 3

Focus Area–Number Sense and Systems

EIGHTH GRADE OUTCOME:

The student investigates the history and structure of the rational number system.

Outcome Illustration: models and explains the relationships among counting numbers, whole numbers, integers, fractions, and rational numbers

Give specific members for each set or have students generate their own elements each set, such as:

Counting: 1, 2, 3, 4, 15
Whole: 0, 1, 2, 3, 23
Integers: -3, -2, -1, 0, 1, 2, 3
Fractions: 1/4, 2/3, 5/5, 1 1/2, 3/34, 1
Rational Numbers: -5/3, -1/12, 5/8, 21

Have the students make a Venn diagram demonstrating the relationship among these counting numbers, whole numbers, integers, fractions, and rational numbers.
Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base, Reasoning, Communication and Procedures

Outcome Illustration: understands and appreciates the need for numbers beyond the whole numbers, simple fractions, mixed numbers, and decimals

Given a 10 cm x 3 cm rectangle, find the length of the diagonal.

Hint: Diagonal = $\sqrt{109}$ which demonstrates the need for numbers beyond decimals.
Mathematics Program Outcomes: 2, 4, 5, 8, and 9
Quality Performance Accreditation Student Outcomes: 3, 4, and 5
Assessment Classification: Procedures

An astronomer is calculating distances between planets at certain times of the year. Why would she appreciate scientific notation?
Mathematics Program Outcomes: 2, 3, 4, 7, 8, and 9
Quality Performance Accreditation Student Outcomes: 2, 3, 4, and 5
Assessment Classification: Procedures

John is balancing his checkbook and finds out that he made a mistake in copying down the amount of a check. Instead of writing $1,000, he copied the amount as $100. If he thought he had $247 dollars in his checking account, how much does he now have in the account? How would a bank show this balance?
Mathematics Program Outcomes: 2, 3, 4, 5, 6, 7, 8, and 9
Quality Performance Accreditation Student Outcomes: 2, 3, 4, and 5
Assessment Classification: Procedures and Knowledge Base

Can you divide 100 into exactly 3 parts? How do you represent each part as a decimal?
Mathematics Program Outcomes: 2, 3, 4, 6, 7, 8, and 9
Quality Performance Accreditation Student Outcomes: 2, 3, 4, and 5
Assessment Classification: Knowledge Base

Outcome Illustration: explores irrational numbers such as pi and square roots

Given a variety of circular objects, have the students measure the circumference and diameter of each and compute the ratio of c/d. Compare the results to discover a common estimation of pi.
Mathematics Program Outcomes: 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Concepts and Procedures

Mathematics Curriculum Outcome 4

Focus Area–Number Sense and Systems

EIGHTH GRADE OUTCOME:

The student explains, models, and performs operations and estimates results with algebra and the rational number system to solve problem situations within and outside mathematics.

Outcome Illustration: selects and uses appropriate rational number estimation and computation

Use fraction pieces to show that 3 3/4 divided by 2 1/2 = 1 1/2. What do you have 1 and 1/2 of?

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Concepts and Procedures

Sharon wants to buy a used car for $6,800. The car dealer gave Sharon two options for buying the car. She could pay the full amount in cash, or she could pay $2,000 down and $230 a month for 24 months on the installment plan. Compare Sharon's options and discuss under what conditions Sharon would chose an option.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, 8, and 9
Quality Performance Accreditation Student Outcomes: 2, 3, 4, and 5
Assessment Classification: Problem Solving and Procedures

Brian is ordering photocopier paper. He can purchase a 10-pack box with 200 sheets in a pack for $18, or he can get a 5-pack box with 500 sheets per pack for $20. Which is the better buy? Defend your answer.

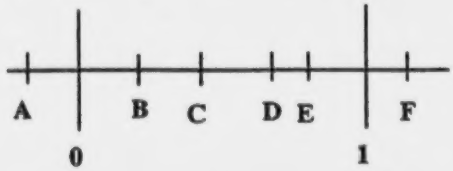
Mathematics Program Outcomes: 1, 2, 3, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving and Procedures

A standard cassette tape player runs the tape over its heads at a speed of 1 7/8 inches per second. If the tape were unwound it would be approximately the length of which of the following? REMEMBER - a 60-minute cassette means recording up to 30 minutes on each side. Explain your answer.

a. a telephone pole
b. a basketball court
c. a football field
d. the distance you could walk in 5 minutes at a fast pace.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures

If the fractions represented by points C and D on this number line are multiplied, what point will represent the product? Defend your answer.



Mathematics Program Outcomes: 1, 2, 3, 4, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Concepts, Knowledge Base, and Communication

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Which of the following problems is different from the rest?

a. Joan has twelve pieces of candy. She plans to give them equally to her three friends. How much candy will each friend get?
b. The five members of the school basketball team each scored the same number of points. If the whole team scored eighty points, how many points did each player make?

(Continued on next page.)

EIGHTH GRADE OUTCOME:

The student explains, models, and performs operations and estimates results with algebra and the rational number system to solve problem situations within and outside mathematics.

c. Bob has four dogs. Each dog eats twelve ounces of dog food every day. How much dog food must he buy each week to feed his dogs?

d. I bought 15 apples for $2.85. How much did each apple cost?

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures

When adding integers having the same sign, what should be done? Explain your answer.
Mathematics Program Outcomes: 1, 2, 3, 4, 5, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures and Communication

Outcome Illustration: selects and uses appropriate rational number estimation and computation

Outcome Illustration: selects and uses appropriate computational tools

John needs $27 to buy a skate board. He earns $4 per hour for mowing lawns and $3 per hour for doing child care. What are all the possible ways that he can earn the money needed?
Mathematics Program Outcomes: 1, 2, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 3, and 4
Assessment Classification: Problem Solving

One million candies need to be packed in boxes placed in cartons loaded on a truck. How many trucks are needed if 60 candies are placed in each bag, 24 bags are in each carton and the cartons are stacked 6 across, 10 deep, and 5 high in the truck?
Mathematics Program Outcomes: 1, 2, 5, 7, and 8
Quality Performance Accreditation Student Outcomes: 3, and 4
Assessment Classification: Procedures

Outcome Illustration: develops and explains computational procedures and estimation strategies

If during a science lab experiment, it is discovered that cells divide to reproduce two new cells once every seven minutes, how many new cells will there be at the end of one hour? Make a graph to illustrate your findings. Estimate how long it will take for 1 million new cells to be formed. Verify the accuracy of your prediction.
Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures, Problem Solving, Knowledge Base, and Communication

You are to be in charge of planning a field trip to four locations in Kansas. One of the locations must be of historical significance, one must be to a fun place, one must be at least one hundred miles from your own town and the fourth choice can be anywhere you want to go. Develop procedures for selecting the four locations and prepare a plan including the time it will take to reach each of the locations, mileage, and how long one would spend at the location to appreciate it. Calculate the cost of the trip using the type of transportation that your school usually uses for field trips. Would it be feasible to come home each night or to spend one or more nights in a motel when you travel? What are the admission charges that must be paid? Prepare a presentation to your class to persuade them to choose your plan.
Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, 8 and 9
Quality Performance Accreditation Student Outcomes: 2, 3, 4, and 5.
Assessment Classification: Problem Solving, Communication, and Procedures

(Continued on next page.)

Mathematics Curriculum Outcome 4

Focus Area–Number Sense and Systems

EIGHTH GRADE OUTCOME:

The student explains, models, and performs operations and estimates results with algebra and the rational number system to solve problem situations within and outside mathematics.

Suppose another school challenged your school to try and read one million pages in library books in your free time or at home. How realistic would this goal be for your school? Approximately how long would it take? Suppose a local pizza company was willing to give your school a pizza party if you could accomplish the million pages in a year. Would you try to persuade your school to meet the challenge? Why or why not?

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, 8, and 9
Quality Performance Accreditation Student Outcomes: 2, 3, 4, and 5
Assessment Classification: Problem Solving

Jamal wanted to buy a video disk that was priced at $10. The sales tax on any purchase was 4 percent. Which questions below could be answered given only this information? You do not need to compute the answer to any of the questions. Just select any question(s) that could be answered from the information.

a. What is the amount of change Jamal received if he gave the clerk a ten dollar bill and a five dollar bill?
b. What is the total cost for his purchase?
c. If he received 16 cents in change after paying for the purchase, how much money did he give the clerk?
d. How much did the store pay for the video disk.
e. How much change did Jamal receive from the clerk after purchasing the video disk?
f. How much change would Jamal need to pay the sales tax?
g. What proportion of the price of the video disk was to be paid as sales tax?
h. What proportion of the total cost was paid as sales tax?

Mathematics Program Outcomes: 1, 2, 3, 5, 6 7 and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures and Problem Solving

Janet has taken her car into the service station to be tuned. The station's prices for the parts and labor needed for the tune-up are given below.

8 spark plugs at $2.75 a plug
1 set of points at $3.39 a set
1 condenser at $1.14 a condenser
1 and 1/2 hours of labor at $5.00 an hour

If there is a 5.9 percent sales tax on parts and labor, what is the total cost of the tune-up including parts and labor?

Mathematics Program Outcomes: 1, 2, 3, 5, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures and Knowledge Base

Outcome Illustration: uses estimation to check reasonableness of results

Your teacher is ill and the substitute has accidentally spilled coffee on the example for today's work. If two digits are unreadable give the range of possible values for the product.

$(5.382 \times 10^{4}) \times (2.$[illegible]$6 \times 10^{2})$

Your friend has calculated the answer to be 2.73252×10^{7}. Using estimation, is this answer reasonable? Explain why or why not.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures, Reasoning, and Knowledge Base

Mathematics Curriculum Outcome 5

Focus Area–Patterns, Functions, Algebraic Concepts, and Relationships

EIGHTH GRADE OUTCOME:

The student recognizes, describes, extends, develops, and explains a wide variety of patterns from problem situations within and outside of mathematics.

If during a science lab experiment, it is discovered that cells divide to reproduce two new cells once every seven minutes, how many new cells will there be at the end of one hour? Make a graph to illustrate your findings. Estimate how long will it take for 1 million new cells to be formed. Verify the accuracy of your prediction.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures, Problem Solving, and Communication

A home owner plants six tulip bulbs. The first spring all six bulbs bloom and each one produces two new bulbs. The second spring the six original bulbs bloom again and each produces two new bulbs. The young bulbs produced the first year mature and blooms the third spring. If this pattern continues, how many tulips bloom the fifth spring?

Mathematics Program Outcomes: 1, 2, 3, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures, Reasoning, and Communication

A bakery produces six cream filled zingers a second. If the machine runs for twenty hours a day, how many zingers will be produced:

a. at the end of one day's production?
b. at the end of a five-day work week?
c. at the end of each work day worked this month (year)?

Mathematics Program Outcomes: 1, 2, 3, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures

Suppose that five rabbits are introduced into an area. If their population doubles every three months and the young rabbits can reproduce after six months, what would be the population in the area after five years?

Mathematics Program Outcomes: 1, 2, 3, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving, Procedures, and Reasoning

A quiz game is played where if a question is answered correctly, ten points are awarded. If the question is answered incorrectly, the person loses five points. Each contestant is asked ten questions.

a. Construct a chart that will identify all possible points a contestant could get.
b. Give a rule that identifies the relationship between the possible total points and the number of questions contestants get correct and incorrect. First, write the relationship in words, then write it as an equation.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures and Communication

Investigate what happens when different sized cubes are constructed from unit cubes, the surface painted, and the large cube is then disassembled into its original unit cubes. How many of the unit cubes are painted on three faces? two faces? no faces?

Mathematics Program Outcomes: 1, 2, 3, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving and Reasoning

Mathematics Curriculum Outcome 6

Focus Area–Patterns, Functions, Algebraic Concepts, and Relationships

EIGHTH GRADE OUTCOME:

The student recognizes and describes linear functions and uses appropriate graphing technology to graph and analyze linear functions.

Play "Guess My Rule." Or complete a table when given 2 of its 3 components.

Input x	Rule 2x + 3	Output
1	2(1) + 3	4
?	2(?) + 3	9
5	?	?

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures

A quiz game is played where if a question is answered correctly, ten points are awarded. If the question is answered incorrectly, the person loses five points. Each contestant is asked ten questions.

a. Construct a chart that will identify all possible points a contestant could get.
b. Give a rule that identifies the relationship between the possible total points and the number of questions contestants get correct and incorrect. First, write the relationship in words, Then write it as an equation.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures and Communication

Mathematics Curriculum Outcome 7

Focus Area–Patterns, Functions, Algebraic Concepts, and Relationships

EIGHTH GRADE OUTCOME:

The student recognizes, interprets, explains, and manipulates expressions involving variables. The student uses linear equations and inequalities to solve problem situations within and outside of mathematics.

Outcome Illustration: understands the concept of variable

Explain the difference between the x in box and the x in the expression x + 2.
Mathematics Program Outcomes: 2, 3, 4, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base

If Julie is x years old. Write an expression to show how old she will be in five years.
Mathematics Program Outcomes: 2, 3, 4, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base and Communication

Gerry spent x at the grocery store, y on gas, and z at a restaurant with friends. What do the variable quantities represent?
Mathematics Program Outcomes: 2, 3, 4, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base

Can x + 3 = 7 and y + 3 = 7 represent the same quantity? Explain your answer.
Mathematics Program Outcomes: 2, 3, 4, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base

Outcome Illustration: uses variables to generalize patterns, tables, graphs, and charts

Continue the pattern to complete the table

1st	2nd
2	5
3	10
4	17
—	—
6	—
x	—

Mathematics Program Outcomes: 1, 2, 3, 4, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base and Reasoning

A quiz game is played where if a question is answered correctly, ten points are awarded. If the question is answered incorrectly, the person loses five points. Each contestant is asked ten questions.

a. Construct a chart that will identify all possible points a contestant could get.
b. Give a rule that identifies the relationship between the possible total points and the number of questions contestants get correct and incorrect. First, write the relationship in words, then, write it as an equation.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures and Communication

(Continued on next page.)

Mathematics Curriculum Outcome 7

Focus Area–Patterns, Functions, Algebraic Concepts, and Relationships

EIGHTH GRADE OUTCOME:

The student recognizes, interprets, explains, and manipulates expressions involving variables. The student uses linear equations and inequalities to solve problem situations within and outside of mathematics.

Outcome Illustration: explains the difference between an equation and an expression

Identify each of the following algebraic representations. Explain their similarities and differences.

$x + 5 = 3$ $\qquad$ $y + 3$

Mathematics Program Outcomes: 2, 3, 4, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Reasoning and Concepts

Outcome Illustration: verbalizes the meaning of symbolic expressions

Design an activity where the students working in cooperative groups represent problem situations verbally and with symbolic expressions. Combine the cards of all groups and then ask students to match the symbolic expression with the verbal description.

For Example: Matching Activity

Card 1	Card 2
Mary has 6 apples and 2 oranges. She has less fruit than John.	$6 + 2 < x$

Mathematics Program Outcomes: 1, 2, 3, 4, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base and Communication

A home owner plants six tulip bulbs. The first spring all six bulbs bloom and each one produces two new bulbs. The second spring the six original bulbs bloom again and each produces two new bulbs. The young bulbs produced the first year mature and bloom the third spring. If this pattern continues, write an algebraic expression to show how many tulips will bloom the fifth spring?

Mathematics Program Outcomes: 1, 2, 3, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures, Reasoning and Communications

Mathematics Curriculum Outcome 8

Focus Area–Patterns, Functions, Algebraic Concepts, and Relationships

EIGHTH GRADE OUTCOME:

The student develops and uses models to represent and justify mathematical relationships and to assist in the solution of problem situations within and outside of mathematics.

Working in a cooperative group students use colored toothpicks and colored gumdrops to construct a three-dimensional model that represents the numbers in Pascal's Triangle.
Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Concepts

Suppose that five rabbits are introduced into an area. If their population doubles every three months and the young rabbits can reproduce after six months, construct a model which would help you determine the number of rabbits at any given time.
Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Concepts, Procedures, Problem Solving, and Reasoning

A contractor is hired to dig a swimming pool for your city park. The pool is to be 70 feet wide and 150 feet long. The depth of the pool at the shallow end of the pool is to be 3 feet deep. The bottom slopes at a constant rate to a depth of 10 feet at a point 30 feet from the deep end of the pool. The remaining distance has a constant depth of 10 feet. Call a local construction firm to find out the capacity of one of their dump trucks. Estimate the number of trips to a dumping site it will require to remove the dirt from the park.
Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures and Knowledge Base

An architect was hired to build a monument for a Civil War battlefield. The structure was to be a pyramid made out of cannonballs. The base of the pyramid was to be 81 cannonballs with 9 cannonballs on a side. How many cannonballs were needed to build the monument? (Hint: Make a table and look for a pattern.)
Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures and Knowledge Base

Mathematics Curriculum Outcome 9

Focus Area–Geometry and Spatial Sense

EIGHTH GRADE OUTCOME:

The student develops, recognizes, applies, and compares properties of common geometric figures using appropriate technology, manipulatives, or constructions.

Collect data from which you can compare the amount of paper needed to cover cylinders of various sizes. Use your data to compare the surface areas of the cylinders. Could the same data be used to determine volume? If yes, compare the relationships between the surface area and the volume of each cylinder. If no, what additional information is needed for each can?

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving and Reasoning

What are the similarities and differences between a line, a line segment, and a ray?

Mathematics Program Outcomes: 2, 3, 4, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Reasoning and Knowledge Base

Use a computer program that generates Pythagorean triples. (Note: Many textbooks have BASIC language computer programs already written to do this. The student could enter the program and run it.) What are the first ten Pythagorean triples? (i.e. The ten Pythagorean triples which have the smallest unique whole numbers.)

Mathematics Program Outcomes: 1, 2, 3, 5, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures and Knowledge Base

You and your father build a small cedar chest. Your mother wants you and your father to build another one to store her quilts. She tells you to make so it will hold twice as much. Your father orders twice as much cedar as you used in the small chest. Will you have too much, too little, or the correct amount of wood? Justify your answer.

Mathematics Program Outcomes: 1, 2, 3, 4, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving, Reasoning, and Concepts

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On a geoboard, make two overlapping rectangles such that the intersection of the two rectangles is a square. Record your findings on geodot paper. By repositioning the two rectangles, what other polygons can be created by the intersection? Record your findings on geodot paper.

Mathematics Program Outcomes: 1, 2, 3, 4, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Concepts

Mathematics Curriculum Outcome 10

Focus Area–Geometry and Spatial Sense

EIGHTH GRADE OUTCOME:

The student uses estimation, measurement, and measurement formulas to solve problem situations within and outside of mathematics.

Outcome Illustration: describes attributes of two dimensional figures and common three dimensional figures

Given a written description of a room with actual sizes, build a scale model of the room from the description.
Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Communication, Procedures, and Knowledge Base

Construct a figure with 6 faces and 12 congruent edges.
Mathematics Program Outcomes: 1, 2, 4, 6, and 8
Quality Performance Accreditation Student Outcomes: 3, and 4
Assessment Classification: Knowledge Base and Concepts

Use pattern blocks to help you discover attributes of common quadrilaterals. Report your findings.
Mathematics Program Outcomes: 1, 2, 3, 4, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Concepts and Communication

Construct a Venn diagram to illustrate the attributes of common quadrilaterals or common three dimensional figures.
Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures, Reasoning, and Communication

Pick an object in the room. Write a description of the object without giving the name of the object. Have another student use your description to draw a picture of the object.
Mathematics Program Outcomes: 1, 2, 3, 4, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Communication

Estimate the weight of your math book in grams. Check your estimate using a scale.
Mathematics Program Outcomes: 1, 2, 4, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures

Outcome Illustration: investigates measurement formulas

In cooperative groups of three, use geoboards to investigate the formulas for perimeter and areas of common two dimensional figures. Explore what happens to the figures when parameters change. (i.e., How does doubling one side of a triangle affect the area?)
Mathematics Program Outcomes: 1, 2, 3, 4, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving and Reasoning

(Continued on next page.).

Mathematics Curriculum Outcome 10

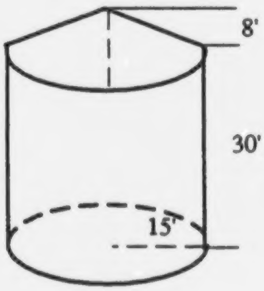
Focus Area–Geometry and Spatial Sense

EIGHTH GRADE OUTCOME:

The student uses estimation, measurement, and measurement formulas to solve problem situations within and outside of mathematics.

Outcome Illustration: applies basic measurement formulas

Working in groups of four, determine the number of cubic feet in this grain storage area. Use reference materials to estimate the number of bushels. How would this information be used by a farmer?



Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, 8, and 9
Quality Performance Accreditation Student Outcomes: 2, 3, 4, and 5
Assessment Classification: Problem Solving and Knowledge Base

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How many seconds are in a day? Discuss with your group whether you think you have lived a million seconds? a billion seconds?

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base and Procedures

A manufacturing company is designing a shape for a new dog food can with a volume of 500 ml.

a. If the cost of the aluminum to build a can is an issue, between what two radii would the can shape require the least amount of material?

b. After considering all factors, a company decided on a conventional shape for the can, choosing a height of 10 cm. What was the approximate radius of the can chosen?

c. Which statement correctly compares the amount of material required to make the can with a radius of 4 cm as compared to the amount of material required to make the can with a radius of 5.5 cm?
(1) There is no difference in the amount of material required
(2) 8-10 percent more material is required for the 4 cm can
(3) Almost twice as much material is required for the 4 cm can
(4) Not enough information

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving, Reasoning, Knowledge Base, Procedures, and Communication

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Anthony is selling ads for the yearbook. He needs to be sure that he sells ads that add up to full pages. The ads the yearbook sells can only have the following dimensions:

Ad Dimensions Available

1 x 2 in
1 x 3 in
2 x 2 in
2 x 3 in
3 x 2 in

(Continued on next page.)

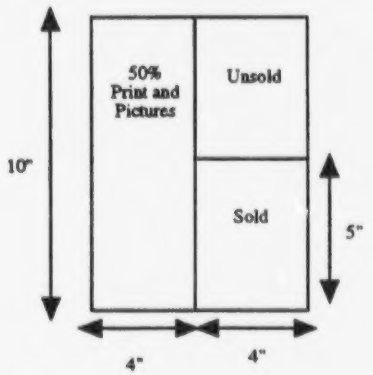
Mathematics Curriculum Outcome 10

Focus Area–Geometry and Spatial Sense

EIGHTH GRADE OUTCOME:

The student uses estimation, measurement, and measurement formulas to solve problem situations within and outside of mathematics.

One of the yearbook pages is shown below. So far for this page, 50 percent is print and pictures, and half of the remaining space is sold. Anthony needs to fill the unsold space with ads.



Identify as many different arrangements of ad combinations as you can find that would fill the unsold space.
Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, 8, and 9
Quality Performance Accreditation Student Outcomes: 2, 3, 4, and 5
Assessment Classification: Problem Solving, Procedures, and Knowledge Base

Outcome Illustration: selects appropriate measurement tools, appropriate units of measurement, and appropriate degrees of accuracy

Tell what measurement tools and units of measurement you would use to find the volume of:

a. your locker
b. your classroom
c. your neighborhood grocery store
d. a watertower

Mathematics Program Outcomes: 1, 2, 3, 4, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base

Plan and compete as a team member in an "Estimation Fair." Include measures of various objects throughout your school–length, area, volume, or capacity. Perform actual measurements for each object to determine the percent of error. Determine who is the best estimator for each category and overall.
Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, 8, and 9
Quality Performance Accreditation Student Outcomes: 2, 3, 4, and 5
Assessment Classification: Problem Solving and Procedures

Outcome Illustration: describes attributes of two-dimensional figures and common three-dimensional figures

Outcome Illustration: selects appropriate measurement tools, appropriate units of measurement, and appropriate degrees of accuracy

Design a new, different piece of playground equipment that could be added to a school yard. Study the size of the students and decide on its appropriate dimensions. Create a drawing from at least two views. Label the dimensions and build a scale model.
Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, 8, and 9
Quality Performance Accreditation Student Outcomes: 2, 3, 4, and 5
Assessment Classification: Problem Solving, Communication, and Procedures

Mathematics Curriculum Outcome 11

Focus Area–Geometry and Spatial Sense

EIGHTH GRADE OUTCOME:

The student investigates and explores two-dimensional geometry from an algebraic perspective to solve problem situations within and outside of mathematics.

Assign the lower left corner peg of the geoboard to be the origin of the Cartesian Coordinate System. Create a polygon on the geoboard. Write the ordered pair of each vertex of the polygon.
Mathematics Program Outcomes: 1, 2, 3, 4, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base and Communication

Investigate how slope is used in construction of houses, construction of roads, construction of ramps for wheelchairs, construction of ramps in parking garages, classification of quality of land by the Soil Conservation Service, and as many other examples as you can find. You may work in small groups of two or three. Summarize your findings for your classmates.
Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, 8, and 9
Quality Performance Accreditation Student Outcomes: 2, 3, 4, and 5
Assessment Classification: Concepts, Reasoning, and Communication

Use a geoboard to make a variety of right triangles of differing sizes and use the Pythagorean Theorem to calculate the hypotenuses of each triangle.
Mathematics Program Outcomes: 1, 2, 3, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, 4, and 5
Assessment Classification: Knowledge Base and Procedures

Mathematics Curriculum Outcome 12

Focus Area–Geometry and Spatial Sense

EIGHTH GRADE OUTCOME:

The student recognizes and performs transformations of two-dimensional geometric figures to solve problems within and outside of mathematics.

Work in small groups for four and select a cartoon, map, or picture from a newspaper. Use a copy machine to reduce it to 80 percent of its original size.

a. How does this reduction affect each dimension?
b. How does this reduction affect the area?
c. Predict the percent enlargement you would need to use to return the item to its original size. Test your prediction.
d. Repeat with other percent reductions and enlargements. Do the enlargement first then predict the required reduction percent needed to return to original size.
e. Summarize your findings in a report to your classmates.

Mathematics Program Outcomes: 1, 2, 3, 4, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Reasoning, Concepts, and Communication

Construct a polygon on a geoboard. Use another geoboard to mark a line of reflection. On a third geoboard or geodot paper, construct the reflection of the polygon on the original geoboard. Students should check each other for accuracy.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Concepts and Procedures

Construct a polygon on a geoboard. Designate a rotation for the polygon, asking the students to draw the resulting polygon on geodot paper. Students should check themselves by rotating the geoboard and comparing the constructed polygon to the one drawn on the geodot paper.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Reasoning

35mm film used by 35mm cameras produce negatives that are 24mm by 36mm. By what factor is this negative magnified when a 5 inch by 7 inch photo is printed? (There is no white border on the print.) What percent of the negative is not printed when the negative is enlarged to produce a borderless 8 inch by 10 inch print? Why is it not possible to print the entire negative when the 8 x 10 enlargement is made?

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base and Reasoning

Mathematics Curriculum Outcome 13
Focus Area–Probability and Statistics

EIGHTH GRADE OUTCOME:

The student explores the use of probability in real-life situations.

Outcome Illustration: devises and conducts experiments and simulations

Outcome Illustration: compares empirical results with theoretical results

Flip a coin 50 times, record the heads and tails as they are flipped. Using the data you recorded
a. What would be your prediction for 1,000 coin tosses?
b. Why do you think so? Justify your answer.
Evaluate the occurrences of the runs or streaks of each heads or tails from your 50 coin toss. What do you conclude would be the greatest run of heads in a toss of 1,000 coins? Justify your answer. Use a computer and simulate a 1,000 coin toss. Compare your results, and discuss the end results.
Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base, Problem Solving, Reasoning, and Procedures

Outcome Illustration: investigates combinatorics and probability theory

If there are 15 different courses available for freshmen, how many different schedules using six different courses can you generate?
Mathematics Program Outcomes: 1, 2, 3, 5, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base and Procedures

Jason said to his mother they always seemed to have the same dinner. His mother said, "That's not true. Just using four meats and four vegetables, I can make different meals each night for at least two weeks." Using the following list of four meats and four vegetables, decide if Jason's mother is correct.

Meats	Vegetables
Chicken	Carrots
Beef	Beans
Fish	Corn
Turkey	Peas

Mathematics Program Outcomes: 1, 2, 3, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures and Problem Solving

Outcome Illustration: recognizes the many uses of probability in the real world

Survey your school on an election issue. Predict the outcome of the election based on your survey results.
Mathematics Program Outcomes: 1, 2, 3, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving and Procedures

The table gives the record for Joan Dyer's last 100 times at bat during the softball season. She is now coming up to bat. Use the data to answer the following questions:

Home runs	0
Triples	2
Doubles	16
Singles	24
Walks	11
Outs	38
Total	100

a. What is the probability that Joan will get a home run?
b. What is the probability that she will get a hit?
c. Based on your data, how many times can she be expected to get a walk in her next fourteen times at bat?

Mathematics Program Outcomes: 1, 2, 3, 4, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base

Mathematics Curriculum Outcome 14

Focus Area–Probability and Statistics

EIGHTH GRADE OUTCOME:

The student generates, reads, organizes and interprets data from problem situations within and outside of mathematics.

Outcome Illustration: understands and applies measures of central tendency (mean, median, and mode)

Students working in pairs record their height in centimeters. Have each group share their data with the entire class. Organize the data and determine mean, median, and mode. Which measure of central tendency least represents the set of data. Justify your answer.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving and Communication

Scientists have discovered that crickets can act as thermometers. By counting the number of chirps in one minute you can estimate the temperature. The following table shows the relationship between number of chirps and temperature.

Chirps a Minute	Estimated Temperature
96	64°
144	76°
160	80°
176	84°
224	96°

Based on the table above which of the following is true?

a. The rate of change is about four chirps for each degree.
b. As the temperature rises the number of chirps per minute increases.
c. Cricket's chirps cause the temperature to rise.
d. The temperature equals one-half the number of chirps.

Mathematics Program Outcomes: 1, 2, 3, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base, Communication, and Reasoning

Outcome Illustration: selects and displays data in appropriate formats

You tell a friend a story. You then each tell the story to another person, then each person who now knows the story then tells another person, and finally everyone repeats the story one more time to another of their friends.

a. Draw a network or map of this story telling experience.
b. How many people heard the story?
c. What is the probability that you would be told if you were in a group of fifty people?

Mathematics Program Outcomes: 1, 2, 3, 4, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Concepts and Communication

The principal asked the fourth grade students to bring old newspapers to school for a recycling project. Each student wrote the number of pounds of newspapers they brought on the board. Here are the number of pounds of newspapers brought by each of the deferent students in the class.

23	24	27	25	26	26	28	31
24	30	25	26	26	27	27	29
26	27	25	33	28	26	25	24

Organize these numbers by making a graph. It may be a line graph, a bar graph, a circle graph, or a picture graph. You may choose the type of graph you want to draw. Label and title your graph.

Mathematics Program Outcomes: 1, 2, 3, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Communication, Procedures, and Problem Solving

(Continued on the next page.)

Mathematics Curriculum Outcome 14

Focus Area–Probability and Statistics

EIGHTH GRADE OUTCOME:

The student generates, reads, organizes and interprets data from problem situations within and outside of mathematics.

Outcome Illustration: identifies and applies valid sampling techniques

You are running for the office of class president at a school of 1,000 students. You need to determine how many students are planning on voting for you. Describe a sampling technique that you can use to best determine what the actual vote will be on election day. Justify your answer. Discuss why political candidates use this type of procedure.

Mathematics Program Outcomes: 1, 2, 3, 5, 6, 7, 8, and 9
Quality Performance Accreditation Student Outcomes: 2, 3, 4, and 5
Assessment Classification: Problem Solving and Procedures

A toy store owner is planning his order of toys for the upcoming holiday season. Describe how the owner of the store can use mathematics to predict how many toys to buy without having too many left over.

Mathematics Program Outcomes: 1, 2, 3, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving and Procedures

Outcome Illustration: calculates and interprets the range of a set of data

Using the newspaper as a resource, gather the barometric pressure readings and precipitation records from a city of your choice over a two-week period. Graph the data on a scatterplot. Determine the line of best fit using a pencil and ruler. What conclusion can you draw? Justify your answer.

Mathematics Program Outcomes: 1, 2, 3, 5, 6, 7. and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures, Communication, and Reasoning

Outcome Illustration: understands and applies measures of central tendency (mean, median, and mode)

Outcome Illustration: selects and displays data in appropriate formats

Outcome Illustration: identifies and applies valid sampling techniques

Outcome Illustration: calculates and interprets the range of a set of data

Using newspapers as a resource collect price data on thirty used cars for sale.

a. determine measures of central tendency
b. display the data in two ways
c. calculate and interpret the mean, median, and mode of the data
d. calculate and interpret the range of the data
e. discuss other possible sources for collecting similar data on the prices of used cars.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, 8, and 9
Quality Performance Accreditation Student Outcomes: 2, 3, 4, and 5
Assessment Classification: Knowledge Base, Communication, and Procedures

Mathematics Curriculum Outcome 15

Focus Area–Probability and Statistics

EIGHTH GRADE OUTCOME:

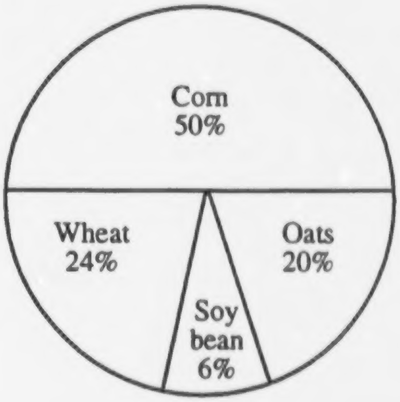
The student uses data analysis, statistics, and probability to generate convincing arguments, to draw conclusions, and to make decisions to solve problem situations within and outside of mathematics.

You have ten items to purchase at a grocery store. Six people are waiting in the express lane (ten items or fewer). Lane 1 has one person waiting, and lane 3 has two people waiting. The other lanes are closed. What check-out line should you join? Justify your answer.

Mathematics Program Outcomes: 1, 2, 3, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, 4, and 5
Assessment Classification: Reasoning and Problem Solving

Use Kansas abstracts and gather data on one of the crops harvested in Kansas. Develop a graph to show the crop production over a period of years. Collect data on the weather for each of the years and on the average price that farmers earned. What effect does price or weather seem to have on production? Discuss this work with your group and submit a written report of your findings.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, 8, and 9
Quality Performance Accreditation Student Outcomes: 2, 3, 4, and 5
Assessment Classification: Problem Solving and Communication



The diagram represents a crop of 30,000 bushels. How many bushels of soybeans were harvested?

Mathematics Program Outcomes: 1, 2, 3, 4, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base

You are a game show participant. You are to select your prize hidden behind one of three doors

1 2 3

Before you begin, your chances of selecting the prize is 1/3. You do not know if the prize is behind the door you selected. The game show host opens a remaining door showing you that the prize is not there. Should you keep the door that you originally chose, or should you switch? Write an argument to convince people what they should do.

Mathematics Program Outcomes: 1, 2, 3, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Reasoning and Communication

Students work in pairs to measure their height, arm span, and wrist measurement in centimeters. Have each student record their own data. Have each student then share their data with the rest of the students in the class. Each student is then responsible for recording all data. Using this information, students should arrange themselves and find the median by the end person raising their hand, transfer the raised hand, going to the center of the line, simultaneously, one at a time from each end. Now locate the lower quartile and upper quartile median the same way. Calculate the outlier, if there is one. Use the data to make a box plot. What conclusions can be drawn about the group by analyzing the values in the "box"

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EIGHTH GRADE OUTCOME:

The student uses data analysis, statistics, and probability to generate convincing arguments, to draw conclusions, and to make decisions to solve problem situations within and outside of mathematics.

portion of the graph? If there is an outlier, what reasons could be given for its occurrence?
Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving, Reasoning, and Concepts

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Provide students with a list of 25 values in cm., arranging from 135 cm. to 199 cm. which represent the heights of a class of students.

a. Organize the data, do a "box plot" analysis, locate median, upper and lower quartile, high and low values.
b. Describe the meaning of the values located in the "box" portion of the box plot.
c. What conclusions can be drawn from this analysis?

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures and Reasoning

Mark one side of 100 centimeter cubes with a permanent marker. Shake the 100 cubes in a box and spill them on the floor. Count, record, and remove the cubes having the marked side showing on top. Gather up the cubes into the box, shake and spill. Repeat the count, record, and remove. Continue until no cubes are left. Discuss how the cubes could represent radioactive atoms and that the number of cubes landing with the marked side up can represent decayed atoms and each roll could represent a constant unit of time. Graph the number of decayed atoms versus time (number of the roll). Graph the number of "radioactive atoms" versus time. Compare the graphs to actual graphs of the radioactive decay of elements. Discuss why this is or is not a good simulation.
Mathematics Program Outcomes: 1, 2, 3, 6, 7, 8, and 9
Quality Performance Accreditation Student Outcomes: 2, 3, 4, and 5
Assessment Classification: Concepts, Communication, and Procedures

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Have students work in pairs to determine if given a group of 50 people, what is the probability that two people will have the same birthday? Simulate this experiment by giving each student a deck of 50 playing cards. Make sure each student has the same 50 cards. (Take out the same two cards from each deck, remove the jokers.) Each person shuffles their deck of cards several times. Simulate that two people match the same birthday by going through decks, each person laying down one card at a time from their deck. If there is a match, this means a birthday match. Continue flipping through the entire deck. Reshuffle and repeat the simulation 10 times. Record and analyze your results. Ask each pair to justify their answer to the questions. Given a group of 50 people, what is the probability that two people will have the same birthday?
Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures, Reasoning, and Knowledge Base

Mathematics Curriculum Outcome 1
Focus Area–Number Sense and Systems

TENTH GRADE OUTCOME:

The student develops and demonstrates number sense for real numbers to solve problem situations within and outside of mathematics.

Outcome Illustration: determines reasonableness of results

You have heard on the radio that someone has won $1 million in the lottery, how much do you estimate they would have to pay in taxes?

a. $500
b. $5,000
c. $10,000
d. $100,000
e. $300,000

Mathematics Program Outcomes: 1, 2, 4, 7, and 8
Quality Performance Accreditation Student Outcomes: 3 and 4
Assessment Classification: Knowledge Base

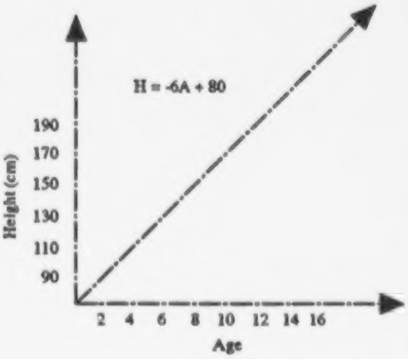
A family of four, two adults and two children, is considering the purchase of a new car. They have decided that they want a four-door car that gets good mileage, has air-conditioning, power-steering, power brakes, AM-FM radio, and a large trunk. Which of the following is a reasonable estimate of the price of a car meeting their requirements?

a. $500
b. $7,000
c. $14,000
d. $25,000
e. $50,000

Mathematics Program Outcomes: 1, 2, 4, 7, and 8
Quality Performance Accreditation Student Outcomes: 3 and 4
Assessment Classification: Knowledge Base

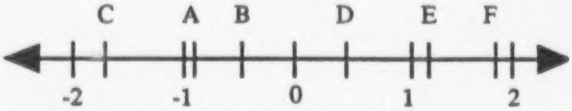
Tom's calculation of the line that fits his data is not reasonable. Why?

Age	Height (cm)
2	87
3	95
4	103
5	110
6	116
7	122
8	127
9	132
10	138
11	143
12	150
13	160
14	163



Mathematics Program Outcomes: 1, 2, 3, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3 and 4
Assessment Classification: Reasoning

Which letter is the most reasonable representation of 5/4 • -2/3?



Mathematics Program Outcomes: 2, 3, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Reasoning

Outcome Illustration: determines relative magnitude of real numbers

√31 is between what two integers?

Mathematics Program Outcomes: 2, 4, and 8
Quality Performance Accreditation Student Outcomes: 3 and 4
Assessment Classification: Reasoning and Knowledge Base

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Mathematics Curriculum Outcome 1

Focus Area–Number Sense and Systems

TENTH GRADE OUTCOME:

The student develops and demonstrates number sense for real numbers to solve problem situations within and outside of mathematics.

The distance from the earth to the moon is about 5×10^5 miles while the distance from earth to the sun is about 9×10^7 miles. The distance from earth to sun is how many times the distance from earth to moon? Express your answer in decimal form.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base

Outcome Illustration: uses multiple representations for the same real number

Write each number below in the following forms: as a radical, on a number line, geometrically, and as a decimal

a. 5
b. the square root of 41
c. π times the $\sqrt{50}$

Mathematics Program Outcomes: 1, 3, 4, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base

Draw a picture to represent 8/3.

Mathematics Program Outcomes: 3, 4, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Concepts

Which of the following are equal to 25/4?

a. 5 1/4
b. 6.25
c. $(5/2)^2$
d. .16
e. $\sqrt{625}/\sqrt{16}$

Mathematics Program Outcomes: 1, 3, 4, 7, and 8
Quality Performance Accreditation Student Outcomes: 3 and 4
Assessment Classification: Knowledge Base

Write a decimal approximation for 5π to the nearest thousandth, then draw a geometric figure to represent it.

Mathematics Program Outcomes: 1, 2, 3, 4, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base and Concepts

Outcome Illustration: estimates quantities using real numbers

A drop of water is approximately one millionth of which of the following?

a. bucket
b. 1/2 bathtub
c. a Kansas lake
d. Pacific Ocean
e all the water in the oceans

Mathematics Program Outcomes: 1, 2, 3, 4, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Reasoning

What is the smallest size container that would be needed to hold one million one-dollar bills?

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving and Reasoning

Determine the weight of a cubic foot of water, then estimate the weight of the water at your local swimming pool.

Mathematics Program Outcomes: 1, 2, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures and Knowledge Base

Mathematics Curriculum Outcome 2

Focus Area–Number Sense and Systems

TENTH GRADE OUTCOME:

The student recognizes, applies, and justifies properties of the real number system and its operations.

Pam wanted to calculate (40+20+5)/5 on her calculator.
She pressed 40 $\boxed{+}$ 20 $\boxed{+}$ 5 $\boxed{\div}$ 5 $\boxed{=}$ and got 61. Is that a reasonable answer? Justify your answer with mathematical properties. If the answer is not reasonable what can Pam do with her calculator to get a reasonable answer?
Mathematics Program Outcomes: 1, 2, 3, 5, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3 and 4
Assessment Classification: Reasoning and Procedures

Use algebra tiles or a geometric figures to represent how the distributive property is used to simplify the expression $x(x + 7)$.
Mathematics Program Outcomes: 2, 4, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3 and 4
Assessment Classification: Concepts

Describe how the distributive property can be used to mentally calculate the cost of six records that cost $8.50 each?
Mathematics Program Outcomes: 1, 2, 3, 4, 5, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base

Explain why you would use the distributive property to mentally multiply $5 \cdot 43$.
Mathematics Program Outcomes: 1, 2, 3, 4, 5, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Communication and Knowledge Base

Explain why you would want to use the commutative and associative property of addition to compute the following sum.

$$3.8 + 5.6 + 6.2 + 1.4 + 8.3 + 1.7 + 8.6 + 4.4$$

Mathematics Program Outcomes: 1, 2, 3, 4, 5, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base and Communication

Given the following problem, what would be the next step in solving the equation? What property are you using?

$$3x(x + 5) = 2(5x - 1)$$

Mathematics Program Outcomes: 1, 2, 4. 5, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, 4, and 5
Assessment Classification: Knowledge Base and Procedures

Use models to demonstrate if the communicative property holds for each of the four operations, multiplication, division, addition, and subtraction.
Mathema'ics Program Outcomes: 1, 2, 3, 4, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Concepts and Reasoning

Give the inverse of each statement listed below.
a. Adding 17 to both sides of an equation.
b. Contracting a figure by a scale factor of 2/3.
c. Rotation of a figure by 120°.
d. $f(x) = 2x - 17$
e. $g(x) = \ln x$
Mathematics Program Outcomes: 2, 3, 4, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base

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Mathematics Curriculum Outcome 2

Focus Area–Number Sense and Systems

TENTH GRADE OUTCOME:

The student recognizes, applies, and justifies properties of the real number system and its operations.

Find the inverse of the matrix:

$$A = \begin{bmatrix} 3 & -1 \\ 2 & 5 \end{bmatrix}$$

Show what you can do to prove the matrix you found is the inverse of A.

Mathematics Program Outcomes: 1, 2, 4, 5, and 8
Quality Performance Accreditation Student Outcomes: 3 and 4
Assessment Classification: Knowledge Base and Procedures

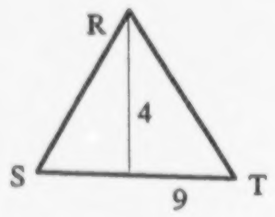
$$A = \begin{bmatrix} 3 & 2 & -1 \\ 4 & 0 & 3 \\ 5 & 1 & 4 \end{bmatrix} \quad B = \begin{bmatrix} 1 & -1 \\ 3 & 2 \\ 0 & 1 \end{bmatrix}$$

a. Compute AB
b. Compute BA
c. What property does this represent and what can you determine about how that property relates to the multiplication of matrices.

Mathematics Program Outcomes: 2, 3, 4, 5, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4 14
Assessment Classification: Knowledge Base

Explain why the communative property of multiplication would make finding the area of ΔRST easier.

Area = 1/2 (base)(height)



Mathematics Program Outcomes: 2, 3, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Reasoning

Mathematics Curriculum Outcome 3

Focus Area–Number Sense and Systems

TENTH GRADE OUTCOME:

The student investigates the history and structure of the real number system.

Outcome Illustration: models and explains relationships among counting numbers, whole numbers, rational numbers, irrational numbers, and real numbers

Classify the following list of numbers as to whether they are counting numbers, whole numbers, rational numbers, irrational numbers, and/or real numbers

7/16	1	$\sqrt{18}$	0
-24/6	$\sqrt{25}$	π	- 5.4
3.14159	93 million	$8.93 \cdot 10^{25}$	$2.76 \cdot 10^{-14}$
$\sqrt{36}/\sqrt{49}$	2^{-3}	$20^{3/2}$	$3\sqrt{2}$

Draw a Venn diagram to show the relationship of the categories above and place each number listed in its appropriate position in the diagram.
Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base, Communication, Reasoning, and Procedures

Outcome Illustration: understands and appreciates the need for numbers beyond the rational numbers

Why can't 3.14 or 22/7 always be substituted for the value of π ?
Mathematics Program Outcomes: 2, 3, 4, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Reasoning and Concepts

Find 1/3 of 1,000 and then use your solution to answer the following question: Can three people equally divide $1,000?
Mathematics Program Outcomes: 1, 2, 3, 4, 5, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base and Reasoning

If every quadratic equation has two roots, why couldn't the solution of the equation $x^2 - 5$ be a rational number?
Mathematics Program Outcomes: 1, 2, 3, 4, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Reasoning

Use references in your school library to explore the history of π. Report your findings to the class.
Mathematics Program Outcomes: 3, 7, 8, and 9
Quality Performance Accreditation Student Outcomes: 2, 4, and 5
Assessment Classification: Communication

Mathematics Curriculum Outcome 4

Focus Area–Number Sense and Systems

TENTH GRADE OUTCOME:

The student explains, models, and performs operations with algebra and the real number system to solve problem situations within and outside mathematics.

Outcome Illustration: selects and uses appropriate real number estimation and computation

A farmer has a field of wheat that must be partially plowed up to meet government requirements for a subsidy payment. He must plow up 40 percent of his field that measures 60 rods by 140 rods. How many rods must he plow off of the edges all the way around the field to meet the requirement.

Mathematics Program Outcomes: 1, 2, 3, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving, Reasoning, and Knowledge Base

William is considering quitting his job which pays him $1,200 per month plus insurance benefits of $250 per month. He wants to start a trucking business which initially will make him an average profit of $2,400 per month. His starting costs will be $30,000 most of which will go towards his truck payment of $600 per month. He will have to pay his own insurance and social security. Does this change in employment seem feasible if his business will increase at 10 percent per year?

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, 8, and 9
Quality Performance Accreditation Student Outcomes: 2, 3, 4, and 9
Assessment Classification: Problem Solving and Procedures

Assume that the costs for a company to produce x items of a product are given by the formula $C(x) = (x^2 - 1)/(x - 2)$ The additional cost to produce one more item is given by the expression $C'(x) = C(x + 1) - C(x)$.

(a) Compute and simplify $C'(x)$.
(b) Evaluate $C'(x)$ for $x = 7$.

Mathematics Program Outcomes: 1, 5, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base

Outcome Illustration: selects and uses appropriate real number estimation and computation

Outcome Illustration: develops, analyzes, and explains computational procedures and estimation strategies

How many hours did it take Pioneer 10's radio signals, traveling at the speed of light to reach Earth from a distance close to Pluto in 1983? Explain how you arrived at your answer.

Mathematics Program Outcomes: 1, 2, 3, 5, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving and Knowledge Base

You have a car with an accurate odometer (mileage indicator). The car does not have a trip odometer. You want to determine the miles per gallon you will get when driving your car. Describe exactly the steps you would go through to compute the car's miles per gallon.

Mathematics Program Outcomes: 1, 2, 3, 5, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3 and 4
Assessment Classification: Procedures

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Mathematics Curriculum Outcome 4

Focus Area–Number Sense and Systems

TENTH GRADE OUTCOME:

The student explains, models, and performs operations with algebra and the real number system to solve problem situations within and outside mathematics.

Outcome Illustration: selects and uses appropriate computational tools

What is the most appropriate computational method to use in order to find the solution to each of the problems listed below? Explain your answer.

a. 85 x 100
b. 247 ÷ 98.5
c. $2.5 \cdot 10^6$
d. 6x = 12
e. Sales tax of 5 1/4 percent on the purchase of a new car.

Mathematics Program Outcomes: 2, 3, 4, 5, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures and Concepts

Outcome Illustration: develops, analyzes, and explains computational procedures and estimation strategies

Outcome Illustration: uses estimation to check reasonableness of results

Find the ratio, to the nearest tenth of a percent, of the surface gravity on the moon to the surface gravity on earth. How much would a 195 lb. person weigh on the moon?

Mathematics Program Outcomes: 1, 2, 4, 5, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3 and 4
Assessment Classification: Reasoning and Procedures

Mathematics Curriculum Outcome 5

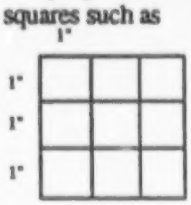
Focus Area–Patterns, Functions, Algebraic Concepts, and Relationships

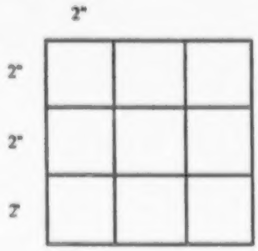
TENTH GRADE OUTCOME:

The student recognizes, describes, extends, develops, and analyzes a wide variety of patterns from problem situations within and outside of mathematics.

A very large plastic sheet was used to cover a football field. A member of the grounds crew recalled that the crew folded this sheet in half 30 times in the process of taking the sheet off the field and putting it up. Investigate this and comment on what the crew member recalled.
Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Concepts, Problem Solving, and Reasoning

Simulate a carnival game where a round chip with a diameter of 1" is tossed on a game board. Students should make several game boards with sides measuring 1", 2", 3", 4", etc. Students toss round chips on game boards and record the results. Students gather and record the data in table form. Students then describe the probability of a chip touching the edge when tossed on a 1" game board; students then describe the probability of a chip touching the edge when tossed on a 2" game board, etc. An extension of the activity would be to algebraically describe the probability pattern. This activity could also be extended by using a game board with several 1", 2", 3" squares such as





Mathematics Program Outcomes: 1, 3, 4, 5, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Concepts, Procedures, and Problem Solving

Give each student a sheet of paper. Students are to tear the paper in half; then tear one of the pieces in half and continue this process. Students are then asked what the sum of the pieces will be and to write the series with numbers.
Mathematics Program Outcomes: 1, 2, 3, 4, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Concepts and Reasoning

Students are asked to write a simple computer program to compute the sum of 1/2 + 1/4 + 1/8 + 1/16, etc. How many iterations must the computer do to have a sum within .0001 of one.
Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Reasoning and Knowledge Base

A fast-food restaurant sells 1,000 hamburgers every day. In order to increase profits, the manager decides to increase the price of the hamburgers by 1¢ each week: Week 1 - hamburgers cost 85¢; Week 2 - hamburgers cost 86¢; Week 3 - hamburgers cost 87¢, etc. Because of the increase in the cost of the hamburgers, the manager finds that a decrease of 10 percent of sales results in: Week 1 - 1,000 hamburgers are sold; Week 2: 900 hamburgers are sold; Week 3: 810 hamburgers are sold. Develop a table and graph to illustrate the results of the manger's decision to increase the price of the hamburgers. As a result of the graph, describe and analyze the managerial decision made.
Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, 8, and 9
Quality Performance Accreditation Student Outcomes: 2, 3, 4, and 5
Assessment Classification: Reasoning and Communication

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Mathematics Curriculum Outcome 5

Focus Area–Patterns, Functions, Algebraic Concepts, and Relationships

TENTH GRADE OUTCOME:

The student recognizes, describes, extends, develops, and analyzes a wide variety of patterns from problem situations within and outside of mathematics.

A computer program is created to generate the terms of a geometric sequence as follows:

```
10 PRINT "TERMS OF A SEQUENCE"
20 FOR N = 1 TO 100 (to print 100 terms)
30 LET T = 5*N - 2     (the formula for the sequence)
40 PRINT T
50 NEXT N
60 END
```

Predict the output for the 43rd term.
Extension: Modify the program to print the series which are the partial sums of the terms of the sequence.

Mathematics Program Outcomes: 1, 2, 3, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Reasoning and Procedures

You are offered a job as a Realtor and receive a base salary of $10,000 per year, plus a bonus of $600 for each house you sell. Express your expected income as a formula based on your sales success.

Mathematics Program Outcomes: 1, 2, 3, 4,
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Communication

Use an algebra manipulative to discover a pattern for squaring a binomial. Describe the pattern using a formula.

Mathematics Program Outcomes: 2, 3, 4, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Concepts and Communication

An ancient oriental game is called the Tower of Hanoi. This game consists of three pegs and several disks of graduated sizes. The disks are moved one at a time to another peg and a larger disk cannot be placed on a smaller disk. What is the fewest number of moves necessary to move the entire stack to another peg so that they are arranged from largest on bottom to smallest on top? Look for a pattern based on the number of disks and the number of moves necessary. Express this pattern as an algebraic formula.

Mathematics Program Outcomes: 1, 2, 3, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving, Reasoning, and Communication

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Use geoboards (or pencil and paper) to form polygons having various numbers of sides. Create a table comparing the number of sides and the number of possible diagonals. How many diagonals could a 17-gon have? Extend your patterns for an n-gon.

Mathematics Program Outcomes: 1, 2, 3, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Reasoning

Traffic lights are timed to follow a cyclical pattern. These can be regulated to control the flow of traffic at peak periods of the day. Analyze the sequence and timing necessary to facilitate various needs at intersections in your community.

Mathematics Program Outcomes: 1, 2, 3, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving and Reasoning

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Mathematics Curriculum Outcome 5

Focus Area–Patterns, Functions, Algebraic Concepts, and Relationships

TENTH GRADE OUTCOME:

The student recognizes, describes, extends, develops, and analyzes a wide variety of patterns from problem situations within and outside of mathematics.

Locker problem — A high school with an enrollment of 850 students has scheduled registration on Monday. When students arrive at school all lockers are closed. Joe, who is the first student to enroll, opens ALL lockers and leaves the lockers open. Jane, the second student to enroll, closes lockers numbered 2, 4, 6, 8, etc. Samantha, the 3rd student who enrolls, changes the position of lockers numbered 3, 6, 9, 12, etc. In other words, she closes locker #1 (which was open), she opens locker #6 (which was closed), she closes locker #9, etc. The 4th student to enroll changes the position of the doors on lockers numbered 4, 8, 12... Describe the pattern which results after 100 students have enrolled. Predict what lockers will be open after 400 students have enrolled.

***Mathematics Program Outcomes:** 1, 2, 3, 5, and 8*
***Quality Performance Accreditation Student Outcomes:** 2, 3, and 4*
***Assessment Classification:** Reasoning and Procedures*

Describe in words and algebraically the pattern of 5, 6, 9, 10, 13, 14, etc.

***Mathematics Program Outcomes:** 1, 2, 3, 4, and 8*
***Quality Performance Accreditation Student Outcomes:** 2, 3, and 4*
***Assessment Classification:** Communication*

Outcome 6

Focus Area–Patterns, Functions, Algebraic Concepts, and Relationships

TENTH GRADE OUTCOME:

The student recognizes, defines, and describes a wide variety of functions, and uses appropriate graphing technology to graph and analyze functions.

Outcome Illustration: determines intercepts, maximums, and minimums

A person bought sixty yards of fencing to enclose his garden. He wants a rectangular garden, and needs to decide what dimensions to make the garden.

a. Write the function which would determine the area of the garden.
b. Graph the function on your calculator.
c. What dimensions would give the maximum area for the garden?
d. In what situations might you want to plant the minimum garden area?

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, 8, and 9
Quality Performance Accreditation Student Outcomes: 2, 3, 4, and 5
Assessment Classification: Knowledge Base, Procedures, and Reasoning

Nabisco wishes to package their new cereal, chocolate coated coconut cereal, in boxes the shape of a rectangular prism. The boxes will be formed from 10" x 20" rectangles. Develop the algebraic function that could be used to determine the boxes' dimensions. Graph this function on your calculator. Use your calculator to determine the package dimensions.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving and Knowledge Base

A ball is thrown from the top of a building 65 feet high. The height (h) of the ball above the ground after t seconds is given by:

$h = 16t^2 + 48t + 65$

Use a computer or graphing calculator to answer the following questions.

a. When is the ball 80 feet above the ground?
b. When is the ball the same height as the building?
c. What is the greatest height that the ball attains?
d. When does the ball hit the ground?
e. Your graph extends to the left of the y-axis and below the x-axis. What significance is this to the ball throwing problem?

Mathematics Program Outcomes: 1, 2, 3, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3 and 4
Assessment Classification: Procedures and Reasoning

Outcome Illustration: understands general characteristics of functions

Sketch a reasonable graph for the following situations:

a. The initial charge for a cab is $2.00 plus 10¢ for each mile. Graph the cost to be charged for rides from 2 miles to 15 miles.
b. Joe has 3 hours to spend each day either riding his motorcycle or reading. Graph the possible ways Joe's time could be spent.
c. Graph the height that a rocket will be off the ground in relation to the number of seconds after the rocket has been fired.
d. Graph the time it takes for you to walk home from school in relation to the number of blocks you live from your school.

Extension: Write an algebraic equation for each graph.

Mathematics Program Outcomes: 1, 2, 3, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Communication and Reasoning

(Continued on next page.)

Outcome 6

Focus Area–Patterns, Functions, Algebraic Concepts, and Relationships

TENTH GRADE OUTCOME:

The student recognizes, defines, and describes a wide variety of functions, and uses appropriate graphing technology to graph and analyze functions.

For each of the following, sketch a reasonable graph and identify the type of function it would be (linear, quadratic, or periodic).

a. The depth of the water at the beach depends on the time of day due to the motion of the tides.
b. A gymnast is jumping up and down on a trampoline. Her distance from the floor depends on time.
c. The distance you go depends on how long you have been going (at a constant speed.)
d. The amount of money you earn at a given hourly wage depends upon the number of hours you work.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3 and 4
Assessment Classification: Communication and Reasoning

Outcome Illustration: analyzes the effects of parameter changes on the graphs of functions

Consider the absolute value function of the form $f(x) = a|x-h|$. Let $h = 3$. Vary the value of $f(x)$, choosing any numbers you wish for a and h. What effect does changing a or h have on the graph?

Mathematics Program Outcomes: 1, 2, 3, 4, 6 and 8
Quality Performance Accreditation Student Outcomes: 2, 3 and 4
Assessment Classification: Reasoning

Compare and then discuss the graphs of the following functions:

$$f(x) = 2(x+3)^2$$
$$f(x) = 1/2\,(x+3)^2$$
$$f(x) = 10\,(x+3)^2$$

Mathematics Program Outcomes: 2, 3, 4, and 8
Quality Performance Accreditation Student Outcomes: 2, 3 and 4
Assessment Classification: Reasoning

Outcome Illustration: analyzes the effects of parameter changes on the graphs of functions

Outcome Illustration: translates among tabular, symbolic and graphical representation of functions

Outcome Illustration: translates among tabular, symbolic, and graphical representation of functions

Analyze the data below of bacterial growth.

Hours	Bacterial Growth
0	10
1	15
2	22
3	33
4	50
5	75
6	113

a. Give the function that represents this growth.
b. Graph this function on your calculator
c. From your graph, predict the growth after 20 hours. Does your prediction correspond to the exact calculation?

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3 and 4
Assessment Classification: Reasoning and Knowledge Base

Postal rates are graduated with the price based on the weight of the item. Rates act as step functions because the price jumps between various weights. Investigate current rates and sketch a graph of the step function.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Communication and Knowledge Base

Mathematics Curriculum Outcome 7

Focus Area–Patterns, Functions, Algebraic Concepts, and Relationships

TENTH GRADE OUTCOME:

The student uses algebra to represent and solve problems situations within and outside of mathematics.

Outcome Illustration: recognizes, interprets, and manipulates variable quantities

Match the equation to its graph to its type of function.

Equation	Growth	Function
$f(x) = a\|x - h\| + k$	line	quadratic
$f(x) = m x + b$	parabola	linear
$f(x) = ax^2 + bx + c$	exp. curve	absolute value
$f(x) = b^x$	angle	exponential

Mathematics Program Outcomes: 3, 4, 7, and 8
Quality Performance Accreditation Student Outcomes: 3 and 4
Assessment Classification: Knowledge Base

Solve the following equations for the given variable.

a.	$A = \pi r^2$	r–radius
b.	$y = mx + b$	m–slope
c.	$D = rt$	t–time
d.	$P = 2l + 2w$	l–length
e.	$C = 2\pi r$	r–radius

Mathematics Program Outcomes: 1, 2, 3, 5, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3 and 4
Assessment Classification: Knowledge Base

Prove that the sum of two consecutive odd integers is divisible by 2.
Mathematics Program Outcomes: 1, 2, 3, 4, 5, and 8
Quality Performance Accreditation Student Outcomes: 2, 3 and 4
Assessment Classification: Procedures and Knowledge Base

Assume that the costs for a company to produce x items of a product are given by the formula $C(x) = (x^2 - 1)/(x - 2)$. The additional cost to produce one more item is given by the expression $C'(x) = C(x + 1) - C(x)$.

a. Compute and simplify $C'(x)$.
b. Evaluate $C'(x)$ for $x = 7$.

Mathematics Program Outcomes: 1, 5, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base

In physics, the formula for centripetal force is $F = (mv^2)/r$ where r represents the radius, m represents mass and v represents velocity. Solve the formula for r. Find the length of a string fastened to a 5 kg mass being spun at a speed of 3 meters per second and that has centripetal force of 22.5 newtons acting upon it.
Mathematics Program Outcomes: 1, 2,3, 5 ,7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base

Outcome Illustration: solves linear and quadratic equations

A baseball crosses home plate at a height of 4 ft. The path of the ball is described by the equation below where h is the height of the ball in feet and x is the number of feet the ball is down field.

$$h = -1/729\,(x-162)^2 + 40$$

The outfield wall is 6 ft. tall and 318 ft. from home plate. Will the ball go over the wall for a home run? If so, by how many feet will it clear the wall? If not, by how many feet will it fall short?
Mathematics Program Outcomes: 1, 2, 3, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving and Knowledge Base

(Continued on next page.)

Mathematics Curriculum Outcome 7

Focus Area–Patterns, Functions, Algebraic Concepts, and Relationships

TENTH GRADE OUTCOME:

The student uses algebra to represent and solve problems situations within and outside of mathematics.

Outcome Illustration: solves linear and quadratic inequalities

Outcome Illustration: appreciates the power of mathematical abstraction and symbolism

The following table illustrates the amount of time and metal used in producing two types of jewelry.

	Metal	Time
Ring	40 g	20 min.
Bracelet	120 g	30 min.
Total available	5000 g	40 hr.

If R = number of rings and B = number of bracelets produced, $R \geq 0$, and $B \geq 0$

a. Write an inequality expressing the constraints on the metal used.

b. Write an inequality expressing the constraints on time.

c. The company makes a profit of $5.00 on each bracelet and $2.50 on each ring. Write the equation to find the profit.

d. Sketch the graphs of the equation and inequalities. Use the technique of linear programming to predict the number of rings and the number of bracelets to produce in order the maximize the profits and explain why it would be important information for a business to have.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, 8, and 9

Quality Performance Accreditation Student Outcomes: 2, 3, 4, and 5

Assessment Classification: Knowledge Base and Communication

The local theater presented a play last night. As an incentive to encourage students to attend, the theater owner agreed to donate half of the proceeds from the student tickets to the high school "After Prom" party. The cost was $4.00 for adults and $2.50 for students. The cashier did not keep track of the number of students and adults attending the show, only the total attendance which was 400. The total income for the night was $1,330.

a. Determine how many students attended the play.

b. How much is the theater's donation to the "After-Prom" party.

c. Are variables and equations helpful in solving this problem? Why or why not?

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, 8, and 9

Quality Performance Accreditation Student Outcomes: 2, 3, 4, and 5

Assessment Classification: Knowledge Base and Reasoning

Mathematics Curriculum Outcome 8

Focus Area–Patterns, Functions, Algebraic Concepts, and Relationships

TENTH GRADE OUTCOME:

The student develops and uses models to represent and justify mathematical relationships and to assist in the solution of problem situations within and outside of mathematics.

Invite a guest speaker from your district to explain the networks used in creating school bus routes. Create a simplified model of a bus route so that roads will not be traveled more than once. What other parameters must also be considered in your district's busing plans?

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, 8, and 9
Quality Performance Accreditation Student Outcomes: 2, 3, 4, and 5
Assessment Classification: Problem Solving and Reasoning

An investment company has offices in three locations, Colby, Oskaloosa, and Derby. Its investments in each office are in bonds, mortgages, and consumer loans. The amount of money (in millions of dollars) for each location and category are as shown in the table. The current yields on these investments are 7.5 percent for bonds, 12 percent for mortgages, and 9 percent for consumer loans. Use multiplication of matrices to model the situation and find the total earnings for each of the three offices.

	C	O	D
Bonds	10	18	22
Mort.	8	20	3
Loans	32	17	12

Mathematics Program Outcomes: 1, 2, 3, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base

You are waiting on a train platform to catch a train. A northbound train arrives every 8 minutes and a southbound arrives every 11 minutes. (Create a computer simulation model to show the arrival of the trains.) What is the probability that the next arriving train will be northbound? What is the probability you could catch a train going either direction within 3 minutes?

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures and Knowledge Base

The survey results of students involved in activities were:

42 athletes out for basketball
58 athletes out for track
24 athletes out for gymnastics
12 play both basketball and run track
5 gymnasts play basketball.

Use a Venn diagram to determine how many athletes were surveyed.

Mathematics Program Outcomes: 1, 2, 3, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3 and 4
Assessment Classification: Procedures

Karen is interested in earning some money from a part-time job. She wants to find a job where she can schedule her own time. When looking through the newspaper ads, she finds two ads entitled "TYPIST NEEDED."

Job 1: EARN MONEY IN YOUR SPARE TIME. Weekly will pay $15.00 for the first 100 envelopes addressed; 3 cents for each additional envelope. Maximum pay: 2,000 envelopes weekly.

Job 2: SET YOUR OWN SCHEDULE. Work when time permits. Will pay 5 cents for each envelope addressed. Maximum pay: 2,000 envelopes weekly.

Construct a graph showing the information from the two ads that could be used to help Karen decide which job will earn her the most money. Using your graph, what decision Karen should use to determine which job would be best for her? Explain how mathematics played an important role in Karen's decision.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, 8, and 9
Quality Performance Accreditation Student Outcomes: 2, 3, 4, and 5
Assessment Classification: Problem Solving, Reasoning, and Procedures

Mathematics Curriculum Outcome 9

Focus Area–Geometry and Spatial Sense

TENTH GRADE OUTCOME:

The student recognizes, applies, compares, and justifies properties of geometric figures using appropriate technology, manipulatives, or constructions.

Design and build an elliptical pool table. Put a hole at one focus. Write the rules for playing the game. Determine what marks could be put on the table so the player could always win.
Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving

In words using elaborate mathematical language, write as many sentences as you can to describe one of the following:

a) a coat rack
b) a table
c) a flag on a pole on a windy day
d) hitting a golf ball
e) silhouette/outline of a house
f) rising and setting of the sun

Mathematics Program Outcomes: 2, 3, 4, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Communication and Concepts

Given the intersections of geometric figures below have students predict what the resulting figures would look like and then check their prediction with a computer simulation. Have the students construct geometric models of the intersections.

a. a plane intersecting a cylinder at various angles
b. a plane intersecting rectangular prism at various angles
c. a plane intersecting a cone at various angles
d. a plane intersecting a sphere at various angles

Extension: Explore architectural designs to see how intersections of planes with three-dimensional figures are used aesthetically in design.
Mathematics Program Outcomes: 1, 2, 3, 4, 6, 7, 8, and 9
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Reasoning and Concepts

Graph the following quadratic equations on your graphing calculator (or computer).

$y = 5x^2 + 2x + 3$
$y = x^2 + 2x + 3$
$y = -3x^2 + 2x + 3$
$y = -1/2x^2 + 2x + 3$
$y = -x^2 + 2x + 3$
$y = 1/7x^2 + 2x + 3$

a. How does the value of the coefficient of the quadratic term affect the graph of the function?
b. How do you think the value of the coefficient of the linear term will affect the graph? Check your hypothesis.
c. How do you think the value of the constant will affect your graph? Check your hypothesis.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base and Reasoning

Mathematics Curriculum Outcome 10

Focus Area–Geometry and Spatial Sense

TENTH GRADE OUTCOME:

The student uses estimation, measurement, and geometric properties to solve problem situations with and outside of mathematics.

Outcome Illustration: describes two- and three-dimensional relationships

A solid clay figurine weighs 10 lbs. A similar one which is twice as tall stands next to it. Could a 4-year-old pick up the taller figurine? Justify answer.

Mathematics Program Outcomes: 1, 2, 3, 4, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Reasoning and Communication

Sandwiches in the school cafeteria are 4 inches square and 1 inch thick. Which size bag would hold the sandwich and be the most sensible to use?

a) 4 inches x 4 inches
b) 5 inches x 5 inches
c) 6 inches x 4 inches
d) 6 inches x 6 inches
e) 7 inches x 6 inches

Mathematics Program Outcomes: 1, 2, 3, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Reasoning

Describe a bicycle using as many mathematical terms you can. Use mathematical words and short sentences to describe the bicycle or parts of it. For example, "the tires are in the shape of a circle," or "the pedals are attached at right angles" or "the open spaces in the sprocket look like triangles." Give as many mathematical descriptions in sentences as you can.

Mathematics Program Outcomes: 3, 4, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2 and 4
Assessment Classification: Communication

Outcome Illustration: applies a variety of measurement formulas

A basketball has a diameter of 9.5 inches. If it is placed into a cube-shaped cardboard box for shipping, what percent of the box is empty?

Mathematics Program Outcomes: 1, 2, 3, 5, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base

A box has the dimensions of 2 x 3 x 4 feet. A similar box has dimensions of 4 x 6 x 8 feet. Compare the surface areas and volumes of the two boxes.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base

Draw a diagram and solve the following problem: A recreation center builds a dirt mountain and covers it with artificial snow for skiing. The cone-shaped mountain has a circular base and contains 1,000 tons of dirt. It is to be covered with 10 tons of artificial snow. The area around the base is surrounded by a fence 200 yards long. Business is so good that the owner decides to build another ski mountain of the same shape but twice as high. How much dirt is needed for the new mountain? How much artificial snow is needed? How long of a fence is needed to surround the base?

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving and Knowledge Base

(Continued on next page.)

Mathematics Curriculum Outcome 10

Focus Area–Geometry and Spatial Sense

TENTH GRADE OUTCOME:

The student uses estimation, measurement, and geometric properties to solve problem situations with and outside of mathematics.

Outcome Illustration: justifies simple measurement formulas

Use models and/or graph paper to justify the following area formulas:

a. the area of a parallelogram is the base times the height

b. the area of a triangle is 1/2 the base times the height

c. the surface area of a cylinder is π times the radius squared times the height.

Mathematics Program Outcomes: 1, 2, 3, 4, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Concepts

Outcome Illustration: selects appropriate measurement tools, appropriate units of measure, and appropriate degrees of accuracy

In decorating the gym for a school dance, streamers are to be strung diagonally across the ceiling of the basketball court. Design a method for determining how many rolls of crepe paper should to be purchased.

Mathematics Program Outcomes: 1, 2, 3, 5, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving and Procedures

Outcome Illustration: investigates basic trigonometric relationships

Have each student in your class make several right triangles. Working in groups of four, have the students measure the smaller angle, the measure of the side opposite the smaller angle, and the hypotenuse. Chart the data. How does the side opposite the angle change as the angle changes? How does the ratio of the side opposite the smaller angle to the hypotenuse change as the angle changes? Will the ratio ever be one? Will the ratio ever be zero? Compare other parts of the right triangles.

Mathematics Program Outcomes: 1, 2, 3, 4, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Reasoning and Concepts

Describe how you could use a calculator with trig functions to help find the height of your school building if you knew the distance a person was standing away from building and the angle from the ground to top of the building.

Mathematics Program Outcomes: 1, 2, 3, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving and Reasoning

Mathematics Curriculum Outcome 11

Focus Area–Geometry and Spatial Sense

TENTH GRADE OUTCOME:

The student uses an algebraic perspective to analyze the geometry of two and three dimensions to solve problem situations within and outside of mathematics.

Draw three lines and then draw lines perpendicular to each of the original lines. Find the slopes of the original lines and the perpendicular lines. Compare the slopes of the original lines with the lines perpendicular to them and then write a statement summarizing your results. Can you make a generalization about the relationship between the slopes of two perpendicular lines?

Mathematics Program Outcomes: 1, 2, 3, 4, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Reasoning and Communication

Draw a portion of your city on coordinate graph paper. Use a city block as one unit. Mark on your graph the location of your school, your home or a friend's home, and four other places of interest in your town. Determine the shortest distance from school to the five places you have chosen by using (1) estimation and (2) the distance formula for two points on the coordinate plane.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures and Reasoning

A bug is in the corner of a room that is 12' x 15' by 10'. A string can be attached from one corner to any other corner of the room. Assuming the bug cannot fly but can only crawl along the string, find the shortest length of string that you could use to get the bug from one corner to the other.

Mathematics Program Outcomes: 1, 2, 3, 5, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Reasoning and Problem Solving

Have each student design a three-dimensional coordinate system using sheets of cardboard or plastic. Have one student show a spot in the three-dimensional model. The second student is to name the coordinates of that spot or have the first student give the ordered triples and the second student show the location of the given point.

Extension: Determine how to find the distance from the origin to given point in three-dimensional space.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3 and 4
Assessment Classification: Concepts and Procedures

A ramp for handicapped persons is being considered in Treetown to accommodate persons doing business at the courthouse. The historic courthouse has steps leading to very ornate doors which are 18 feet above ground level. The building code in Treetown indicates a 1" rise for every foot when building handicap ramps. How many feet away from the building will the ramp have to start in order to be within building codes?

Extension: Discuss the building code in your specific town, make a model of the building and the ramp, and write an algebraic equation line representing the ramp.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, 8, and 9
Quality Performance Accreditation Student Outcomes: 2, 3, 4. and 5
Assessment Classification: Knowledge Base and Communication

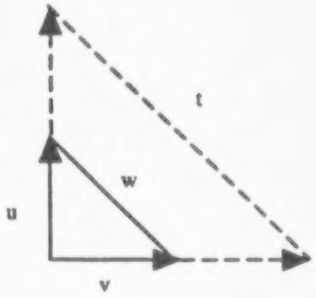
Mathematics Curriculum Outcome 12

Focus Area–Geometry and Spatial Sense

TENTH GRADE OUTCOME:

The student recognizes, develops and applies transformations of geometric figures to solve problem situations within and outside of mathematics.

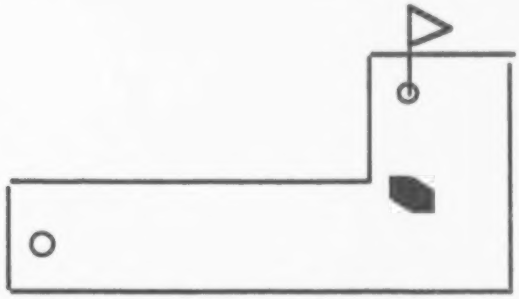
The vector illustration shown illustrates a dilation of vectors u and v by a scale factor of 2 w = w = v and t = 2w - 2v. Confirm or deny that w || t.



(Note: This argument might be approached at several levels - construction and measurement, a coordinate proof, the midline theorem, or a vector proof.)

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures and Reasoning

Apply transformational technology to this miniature golf hole. Show the path that would be needed to make a 2-bank hole-in-one shot.



Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures

Let Δ ABC be a clockwise orientation. Y is the image of Δ ABC under a composite of reflections.

a. What is the orientation of Δ ABC after 6 reflections?
b. What kind of reflections preserve orientations?
c. What kind of reflections don't preserve orientation?

Mathematics Program Outcomes: 1, 2, 3, 4, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3 and 4
Assessment Classification: Knowledge Base and Reasoning

Draw a equilateral Δ and its lines of symmetry. Describe the rotations that will map the Δ to itself.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, and 8
Quality Performance Accreditation Student Outcomes: 2, 3 and 4
Assessment Classification: Knowledge Base and Communication

A man was looking in the mirror and saw the back of his head. How did this happen?

Mathematics Program Outcomes: 1, 2, 3, 4, and 8
Quality Performance Accreditation Student Outcomes: 2, 3 and 4
Assessment Classification: Reasoning

(Continued on next page.)

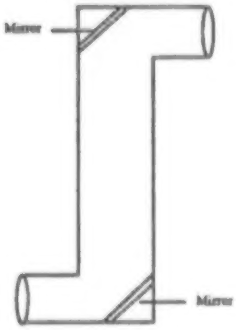
Mathematics Curriculum Outcome 12

Focus Area–Geometry and Spatial Sense

TENTH GRADE OUTCOME:

The student recognizes, develops and applies transformations of geometric figures to solve problem situations within and outside of mathematics.

What transformation principle is used in the development or use of a periscope and how does it work? Explain.



Mathematics Program Outcomes: 1, 2, 3, 4, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Reasoning and Communication

Mathematics Curriculum Outcome 13

Focus Area–Probability and Statistics

TENTH GRADE OUTCOME:

The student formalizes probability theory.

Outcome Illustration: devises and conducts appropriate experiments and simulations for given situations

George Brett has a batting average of .300. How many hits would you predict that he would have in his next 60 times at bat?

Mathematics Program Outcomes: 1, 2, 3, 4, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base

List the totals that are possible when you roll two number cubes which has the numbers 1 through 6 on its faces. In a second column write the probability of each outcome. What is the probability that you would roll a total 7 or greater?

Mathematics Program Outcomes: 1, 2, 3, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Knowledge Base

Outcome Illustration: compares empirical results with theoretical results

If a child is equally likely to be born a boy or a girl, what are the chances that a family of three children will contain exactly one girl? Survey the families in your school which have three children. How do the results compare?

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving

Let a roll of a number cube with the numbers 1 through 6 on its faces represent an at-bat for a baseball player. Let a 5 or a 6 represent a hit, so that the batter gets a hit 1/3 of the time. Let four rolls of the cube constitute a game. Working in groups of two, roll the cube a designates number of times, and record the number of "hits" and "outs" for each "game." Summarize the data in a chart on the board.

Note: Beginning students can graph the results and discuss the distribution of probabilities. Advanced students can use the binomial probability theorem to predict the distribution of no-hit games, 1-hit games, and so on. They can then compare the theoretical results with the actual results of the simulation.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving and Reasoning

Outcome Illustration: applies combinatorics and probability theory

How many different numbers are possible in Kansas' Pick-Three Lottery? If you buy 100 tickets, what are your odds of winning? How many different numbers would be possible in a pick-four lottery?

Mathematics Program Outcomes: 1, 2, 3, 4, 7 and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Concepts and Reasoning

If there are ten people that are qualified to hold office in a certain organization. The three offices are president, vice-president, and secretary. How many possible combinations of officers are there if:

a. each person can hold only one office?
b. if the same person can be vice-president and secretary?

Mathematics Program Outcomes: 1, 2, 3, 5, 7 and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Concepts, Reasoning, and Procedures

Mathematics Curriculum Outcome 14

Focus Area–Probability and Statistics

TENTH GRADE OUTCOME:

The student generates, reads, organizes and interprets data and uses data to draw inferences from problem situations within and outside of mathematics.

Outcome Illustration: analyzes the use of probability in the real world

Outcome Illustration: analyzes the effects of data transformations on measures of central tendency

The salaries of some employees of a school district are listed. The school board is considering giving raises in two possible forms — a 5 percent raise for everyone or a $5,000 raise for everyone. Predict if either of these would affect the mean, median, and mode of this group of salaries.

$75,000
$60,000
$45,000
$42,500
$33,000
$28,000
$25,000
$18,500

Mathematics Program Outcomes: 1, 2, 3, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving and Reasoning

Outcome Illustration: infers appropriate conclusions from data displayed in a variety of formats

Collect graphs from various publications. Study the use of the scales on the axis. Are these graphs skewed in some way to influence the effects on the reader?

Mathematics Program Outcomes: 1, 2, 3, 5, 6, 7, 8, and 9
Quality Performance Accreditation Student Outcomes: 2, 3, 4, and 5
Assessment Classification: Reasoning, Communication, and Procedures

Using a set of data, create a graph which uses a scale change to distort its implications. Pretend you are a reporter and write a news story to go with your graph.

Mathematics Program Outcomes: 1, 2, 3, 6, 7, 8, and 9
Quality Performance Accreditation Student Outcomes: 2, 3, 4, and 5
Assessment Classification: Communication and Reasoning

In 1955 the Dodgers lost the first two games of the World Series against the Yankees, but won the series in the end. In how many ways can the series go so that the losing team wins the first two games? Use a tree diagram to illustrate possible outcomes.

Mathematics Program Outcomes: 1, 2, 3, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving and Reasoning

Outcome Illustration: understands sampling and recognizes its role in statistical claims

Outcome Illustration: understands and applies measures of dispersion

Collect data on test scores from the most recent chapter test given in your math class. Write a letter to your parents indicating the percentile and quartile in which your grade falls. In your letter, be explicit about the meaning of percentile and quartile.

Mathematics Program Outcomes: 1, 2, 3, 4, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Communication and Concepts

(Continued on next page.)

Mathematics Curriculum Outcome 14

Focus Area–Probability and Statistics

TENTH GRADE OUTCOME:

The student generates, reads, organizes and interprets data and uses data to draw inferences from problem situations within and outside of mathematics.

A poll of the president's domestic policies asked people to rate the president on a 10-point scale. Ratings were almost normally distributed, with a mean rating of 6.5. Twenty percent of the people rated the president a 5 or a 6. Based on this information, which other ratings can you predict were given the president by 20 percent of the people?

a. ratings of 2 or 3
b ratings of 3 or 4
c. ratings of 6 or 7
d. ratings of 7 or 8
e ratings of 8 or 9
f. I don't know

Mathematics Program Outcomes: 1, 2, 3, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Reasoning

Outcome Illustration: understands sampling and recognizes its role in statistical claims

Design an experiment to model the process of counting animal populations through tagging by using a large bowl of colored chips. Dip out a few chips and "tag" them by marking an X on them, then return them to the bowl. Mix thoroughly and dip out a random sample. Count the tagged and the plain chips. Write a proportion to predict the number of chips in the bowl.

Mathematics Program Outcomes: 1, 2, 3, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures

Take a random survey of students in your school. Ask:

a. if they work at a part time job.
b. if yes, how many hours a week.

Make a graph to represent your findings and write a report summarizing your findings.

Mathematics Program Outcomes: 1, 2, 3, 5, 6, 7 and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures and Communication

Outcome Illustration: understands and applies measures of dispersion (standard deviation and variance)

A statistician is analyzing some data in which all figures are in the millions. To make calculations simpler and to take up less space in the spreadsheet she is using, she plans to enter 27,000,000 simply as 27. If she does this to all data, what effect will it have on the mean and standard deviation?

Mathematics Program Outcomes: 1, 2, 3, 4, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Reasoning

Look at a graph of SAT scores. What percent of students score within 10 percent of the mean score? What is the difference in scores between students who score in the 95th percentile and the 99th percentile? What other information do you see?

Mathematics Program Outcomes: 1, 2, 3, 4, 6, 7 and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Concepts

(Continued on next page.)

Mathematics Curriculum Outcome 14

Focus Area–Probability and Statistics

TENTH GRADE OUTCOME:

The student generates, reads, organizes and interprets data and uses data to draw inferences from problem situations within and outside of mathematics.

Outcome Illustration: understands sampling and recognizes its role in statistical claims

Outcome Illustration: understands and applies measures of dispersion (standard deviation and variance)

Outcome Illustration: understands and applies measures of correlation

Have students design, develop, and carry out projects to develop an understanding of statistics.

Project suggestions:

a. Relationship of number of hours worked to grades earned.
b. Relationship of number of school hours missed to grades earned.
c. Relationship of number of activities in which students participate to grades earned, etc.

Have students make conjectures about the data, find the line of best fit, and use computer technology to determine the coefficient of correlation.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6 and 7
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving, Reasoning, and Procedures

Mathematics Curriculum Outcome 15

Focus Area–Probability and Statistics

TENTH GRADE OUTCOME:

The student uses data analysis, statistics, and probability to analyze the validity of arguments, draw conclusions and make decisions to solve problem situations within and outside of mathematics.

Design a class research project to analyze the research question: Do tall people run faster?
Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Procedures

The principal asks you, the student body president, what types of drinks should be available in the school soft drink machine. Any profits from sales will be used for school equipment and field trips.

a. List those factors or things you would consider important to help you make a decision about which soft drinks to have in the machine.

b. For the factors or things listed, how would you go about gathering the information you would want to help you make your recommendations to the principal? Be specific. Tell what information you want and how you would gather this information.

c. Describe how you would organize the information gathered for presentation to the principal. Consider how you will assemble the data you have gathered using graphs, tables, charts, or statistics. Use illustrations, models, or examples to help show how you would present the information you would gather.

Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving and Communication

Investigate the quality control program in a factory. Use probability plots to determine the percentage of time that industry meets specifications with their product.
Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving

Your math class had been asked to investigate student preferences for what food the cafeteria should serve. Design a survey instrument and decide how you will sample the student body. Conduct your experiment and then display your results in an appropriate form. Write a recommendation from your findings.
Mathematics Program Outcomes: 1, 2, 3, 4, 5, 6, 7, and 8
Quality Performance Accreditation Student Outcomes: 2, 3, and 4
Assessment Classification: Problem Solving, Procedures, and Communication

HELPFUL RESOURCES

Kansas State Board of Education

If you have any questions regarding this document or any portion of the Kansas State Board of Education's Kansas Mathematics Improvement Program please contact Kim Gattis or any member of the Outcomes Education Team at the following address:

Outcomes Education Team
Kansas State Board of Education
120 E. Tenth
Topeka, KS 66612
Phone (913) 296-3851 or (913) 296-3379

National Council of Teachers of Mathematics (NCTM)

The National Council of Teachers of Mathematics is a not-for profit professional and education association dedicated to the improvement of mathematics education. NCTM has developed a variety of resources to assist teachers and schools to in implementing NCTM's *Curriculum and Evaluation Standards for School Mathematics*, including an 11 book addenda series. In addition each year NCTM sponsors national and regional professional development activities and conferences.

For further information contact:

National Council of Teachers of Mathematics
1906 Association Drive
Reston, VA 22091-1593
Phone (703) 620-9840

MAST ANSWERLINE 1-800-551-MAST or 1-800-551-6278

Looking for the newest way to teach a concept in mathematics, science, or technology? Do you need the latest research on a topic you are teaching? The MAST ANSWERLINE is a toll free service for teachers of mathematics, science, and technology which provides access to a network of resources from industry, education, and governmental agencies. The service can be used by any Kansas or Missouri K-12 teacher of Mathematics, Science, or Technology. (No student calls please.) The answerline is in operation 24 hours a day, seven days a week. Simply phone the answerline at 1-800-551-6278 and leave your request with staff or on the answering machine. The MAST Answerline staff tries to respond to your request by phone and mail within three days.

Kansas State Board of Education
Approved 4/92

Strategic Directions for Kansas Education

The Kansas State Board of Education is charged with the general supervision of public education and other educational interests in the state. While clearly acknowledging the role and importance of local control, the State Board of Education has the responsibility to provide direction and leadership for the structuring of all state educational institutions under its jurisdiction.

The beginning place for determining the mission for the Kansas State Board of Education is the assumption that all Kansas citizens must be involved in their own learning and the learning of others. It is the combined effort of family, school, and community that makes possible the development of a high quality of life. It is the parent who is the first "teacher" of children. As we grow older, we learn that the school, the workplace, and the community support our lifelong learning and our training and retraining. The Board recognizes the responsibility it holds for Kansas educational systems and promoting quality education programs. The mission for Kansas education is:

To prepare each person with the living, learning, and working skills and values necessary for caring, productive, and fulfilling participation in our evolving, global society.

We believe that the strategic directions for the structuring of Kansas education must be organized to:

- create learning communities
- develop and extend resources for parenting programs and early childhood education
- expand learner-outcome curriculum and learner-focused instruction
- provide inclusive learning environments
- strengthen involvement of business and industry in education
- provide quality staff and organizational development.

Kansas State Board of Education
Kansas State Education Building
120 S.E. 10th Avenue Topeka, Kansas 66612-1182

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An Equal Employment/Educational Opportunity Agency

The Kansas State Board of Education does not discriminate on the basis of sex, race, color, national origin, handicap, or age in admission or access to, or treatment or employment in, its programs or activities. Any questions regarding the Board's compliance with Title VI, Title IX, or Section 504 may be directed to the Title IX Coordinator, who can be reached at (913) 296-2424, 120 S.E. 10th Avenue, Topeka, Kansas 66612-1182, or to the Assistant Secretary for Civil Rights, U. S. Department of Education.

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